Agricultural Experiment Station

of the

University of Kentucky

FIFTY-SIXTH ANNUAL REPORT

IMPERIAL MYCOLOGICAL INSTITUTE

Report of the Director

for the year 1943

Experiment Station Staff

BOARD OF CONTROL

Richard C. Stoll, Chairman, Lexington, Ky.
James Park, Lexington, Ky.
H. S. Cleveland, Franklinton, Ky.
R. P. Hobson, Louisville, Ky.
H. D. Palmore, Frankfort, Ky.

Herman Lee Donovan, President

Thomas P. Cooper, Dean and Director

ADMINISTRATION

T. P. Cooper, Director
Frank D. Peterson, Comptroller
O. L. Ginocchio, Secretary

AGRONOMY

E. J. Kinney, Head
Allbritten, H. G., Assistant in Agronomy
[1] Bortner, C. E., Asst. Agronomist
Diachun, Stephen, Asst. Plant Path.
Fergus, E. N., Agronomist, Pasture and Forage Crop Investigations
Freeman, J. F., Assoc. Agronomist
Hardison, J. R., Asst. in Forage Crop Investigations
[1] Henson, Lawrence, Asst. in Forage Crop Investigations
Jeffrey, R. N., Plant Physiologist
Johnson, E. M., Assoc. Plant Path.
Josephson, L. M., Asst. Agronomist
Karraker, P. E., Agronomist Soil Tech.
Kelley, J. B., Agricultural Engineer
[1] Miller, Harold F., Asst. in Agronomy
O'Bannon, L. S., Research Engineer
Terman, Gilbert, Asst. in Agronomy
Valleau, W. D., Plant Pathologist
Weeks, Martin E., Asst. Agronomist
Wood, Julia, Asst. Analyst

ANIMAL INDUSTRY GROUP

W. P. Garrigus, Chairman
Barber, Harold, Head Herdsman
Baute, E. A., Field Agt. Poultry Improvement
Buckner, G. D., In Charge Animal Nutrition
Davis, G. T., Asst. Field Agent in Poultry Improvement
Ely, Forydce, In Charge Dairy Husbandry
Henry, Amanda, Asst. Animal Nutrition
Insko, W. M., Jr., In Charge Poultry Husb.
Morrison, H. B., Jr., Asst. in Dairy Husb.
[2] Nutter, J. W., Dairyman
McConnell, E. S., Asst. in Poultry
Pifer, R. W., Asst. in Animal Husbandry
[1] Ringrose, A. T., Asst. in Poultry
Steele, D. G., In Charge Genetics
Wilford, E. J., Swine, Meats

ANIMAL PATHOLOGY

W. W. Dimock, Head
[1] Bruner, D. W., Assoc. Bacteriologist
[3] Cherry, W. B., Asst. in Bacteriology
Doll, E. R., Asst. Pathologist
Edwards, P. R., Bacteriologist
Hull, F. E., Assoc. Veterinarian
Wyant, Zae, Technician

CHEMISTRY

J. S. McHargue, Head
Bailey, L. S., Assistant Chemist
[1] Hageman, R. H., Assistant Chemist
Rapp, K. E., Assistant Chemist
Scripture, Paul, Assistant Chemist
Shedd, O. M., Chemist
Skinner, J. T., Assistant Chemist
[4] Woodmansee, C. W., Assistant Chemist

CREAMERY LICENSE SECTION

[1] Foster, J. D., Inspector, In Charge
Howard, N. J., Inspector, Acting in Chg.
Brown, J. B., Inspector

ENTOMOLOGY AND BOTANY

W. A. Price, Head
Baugh, Lucy G., Seed Analyst
Deen, Encil, Seed Inspector
Didlake, Mary L., Assoc. Entgst. and Botanist
Fried, Katharine, Seed Analyst
Jewett, H. H., Asst. Research Entgst.
Littell, Mary L., Seed Analyst
McDaniel, Alice, Seed Analyst
Morton, Margaret, Seed Analyst
Ritcher, P. O., Asst. Entgst.
Tilson, Howard G., Nursery Inspector
Vaughn, E. C., Seed Improvement

FARM ECONOMICS

W. D. Nicholls, Head
Beers, Howard W., Rural Sociology
Bondurant, J. H., Farm Management
Byers, G. B., Farm Organization
Gustafson, R. O., Asst. in Forestry
Hornbeck, B. L., Asst. in Forestry
Nesius, E. J., Farm Management

FEED AND FERTILIZER CONTROL

J. D. Turner, Head
Allen, H. R., Chemist
Fitschen, F. W., Inspector
Gault, Lelah, Assistant Chemist
Mathews, Robert, Inspector
Randle, S. B., Chemist
Rose, J. J., Microscopist
Terrell, W. G., Inspector

HOME ECONOMICS

Statie Erikson, Head
Boyden, Ruth, Assistant

HORTICULTURE

A. J. Olney, Head
Armstrong, W. D., Horticulturist
Emmert, E. M., Assistant
Waltman, C. S., Assistant

MARKETS AND RURAL FINANCE

H. B. Price, Head
Brown, A. J., Prices and Statistics
Card, Dana G., Prices and Statistics
Clark, C. M., Markets and Finance
Phillips, C. D., Markets
Roberts, John B., Markets

PUBLIC SERVICE LABORATORIES

L. A. Brown, Head
Fallis, R. W., Asst. Bacteriologist
[1] McGuire, H. S., Jr., Asst. Bact.
Meader, A. L., Asst. Chemist
[5] Parsley, J. E., Asst. Chemist
Shrader, J. A., Asst. Bacteriologist
Terry, Geo. S., Bacteriologist

PUBLICATIONS

J. Allan Smith, Editor
Sherwood, H. N., Asst. Editor

ROBINSON SUBSTATION
(Quicksand, Ky.)

R. W. Jones, Superintendent
Wiggin, G. H., Forester

WESTERN KY. SUBSTATION
(Princeton, Ky.)

S. J. Lowry, Superintendent
Caldwell, L. M., Assistant

[1] In military service
[2] Deceased August 3, 1943
[3] Resigned February 15, 1943
[4] Resigned November 15, 1943
[5] Resigned August 31, 1943

UNIVERSITY OF KENTUCKY

BOARD OF TRUSTEES

Simeon S. Willis, Governor, Chairman, *ex-officio*

John F. Williams, Superintendent of Public Instruction, *ex-officio*

Elliott Robertson, Commissioner of Agriculture, *ex-officio*

Robert Tway, Louisville, Jefferson County

H. S. Cleveland, Franklinton, Henry County

Harry W. Walters, Shelbyville, Shelby County

John S. Cooper, Somerset, Pulaski County

Harper Gatton, Madisonville, Hopkins County

Robert P. Hobson, Louisville, Jefferson County

Lee Kirkpatrick, Paris, Bourbon County

Richard C. Stoll, Lexington, Fayette County

James Park, Lexington, Fayette County

Mrs. Paul G. Blazer, Ashland, Boyd County

H. D. Palmore, Frankfort, Franklin County

Grover C. Creech, Louisville, Jefferson County

LETTER OF TRANSMITTAL

To His Excellency, Hon. Simeon S. Willis, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under the act of Congress approved July 2, 1862," I herewith submit the fifty-sixth annual report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, Director.

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION
For the Year 1943

During this second year of our country's involvement in war, research aimed at meeting war needs in farming has occupied most of the time and effort of the Experiment Station staff. All research in progress has been under constant review to assure that disproportionate emphasis is not placed now on problems that, though important in themselves, could well await solution after the war. This constant striving toward the immediately useful has been especially urgent because (1) the research staff has been greatly reduced by the demands of military service, though partly replenished by assignment to research of some who had formerly given most of their time to teaching, and (2) the need for ever greater farm production in the face of serious scarcity of farm labor and supplies and overburdened facilities for transporting and marketing farm products, has raised new problems of paramount importance that had to be met. There has been not merely a readiness on the part of farmers to make use of the results of research, but an insistence upon increased research effort. In these times the advantages of better methods and carefully tested practices are particularly outstanding.

FARM ORGANIZATION AND MARKETING

Possibilities of Kentucky agricultural production for war.— As a part of the national campaign for increased farm production, a study was made to determine the maximum productive capacity of Kentucky agriculture which might be reached and maintained during the war emergency. The following are the most significant conclusions of the study:

To reach maximum livestock capacity, under wartime conditions, feed production must be increased within the state. Maximum acreages of crops could be reached by increases, compared with 1942, of corn from 2,600,000 to 2,885,000 acres; small grains for pasture from 87,000 acres to 1,006,000 acres; alfalfa hay from 206,000 acres to 371,000 acres; and barley from 155,000 to 289,000. These increases could be brought about by cultivating more land now idle, more small-grain pasture on land cropped for other purposes, a smaller acreage of hay other than

alfalfa, and smaller acreages of wheat and oats. Higher average acre-yields, which might be attained by greater use of fertilizer, would also serve to increase total production of feed crops.

In estimating the number of the different kinds of livestock needed to make best use of the forage and grain crops that could be produced, the decision was based on the relative amounts of grain, harvested roughage, and pasture in the total production of feed, the relative adaptability of the different animals to consume roughage and grain, and the relative nutritive value of the different meats and other animal products. As a high proportion of the feed would be forage and pasture, increases would be called for in the forage-and-grain-consuming animals that would return the greater amount of food units for the feed eaten. The number of grain-consuming animals that would fit best into such a program would be determined by the amount of grain left after the forage-consuming animals were provided for. On this basis, the maximum feed production would support 9 percent more milk cows, 9 percent more hens and pullets, 5 percent more sheep than at the beginning of 1943; 21 percent more hogs than in the year beginning October 1, 1942; 4 percent more chickens than in 1942, and 8 percent fewer beef cows and stocker-feeder cattle than at the beginning of 1943.

Postwar needs and opportunities in Kentucky agriculture.— The war has brought hinderances to agricultural progress but the postwar period will doubtless present special opportunities for improvements in farming and rural living. If the resources and energy which have been devoted to war can be turned to peace, tremendous results can be accomplished. More than 8 percent of Kentucky people left their homes during the first three years of the war, to enter military service or for industrial work in other states. Some of these will return after the war and Kentucky's rural population doubtless will continue to grow. The useful employment of the labor which will be available after the war offers exceptional opportunities for the improvement of rural living.

The well-being of farm people depends upon the productive capacity of agriculture in relation to the number of people who look to agriculture for support. In parts of Kentucky, population is too dense for adequate support from the available agricultural resources. The pressure of population upon the land results in continued migration from these areas. Under such conditions farms are small and means must be found to increase per-capita income on the small farms, if Kentucky rural people are to have a higher standard of living.

Production may be increased and operating costs reduced on many farms by contour cultivation, the viligant use of winter cover-crop pastures, cropping systems which include rotations adapted to the use of level land more intensively than steep land, and the use of soil-building practices. Building terraces on 5 million acres of land, rearrangement of fences on much of this area, annual planting of an additional 4 million acres of winter cover-crop pastures, improvement of 2 million acres of permanent pasture, manufacturing, transporting, and applying annually an additional 1.2 million tons of fertilibzer, and quarrying, crushing, and spreading 16 million tons of ground limestone on Kentucky farms, are postwar opportunities for increasing farm production. This work would add much to the economic welfare of Kentucky rural people and at the same time preserve soil resources for future generations. Production for sale of adapted grass and clover seeds, of hybrid seed corn, and of Balbo rye for seed, offer limited opportunities for individual Kentucky farmers.

Better feeding, sanitation, and disease prevention, and improvement through breeding, especially by artificial insemination, hold opportunities for increased production of livestock and livestock products.

Among the important needs of Kentucky rural people are improvement, repair, and adaptation of farm houses and buildings; extension of electric power and telephones to more than 200,000 farms not now served with these facilities; provision of adequate water supply for both the people and the livestock on farms; and provision of labor-saving machinery for efficient farm operation.

Adequate market information and allweather farm-to-market roads are among the most important marketing needs in Kentucky. In 1940, more than half of the farms were located on dirt roads, and only 45 percent were on hard-surfaced or gravel roads. Motor trucks will be much depleted after the war but they normally form an important link in farm-to-market transportation, even though 75 percent of the farmers of the state do not own a motor truck.

Analysis of farm business in Union, Henderson, and Daviess counties.— Detailed records from 25 farms were obtained for 1941 and 1942. Net farm earnings (total receipts minus expense other than interest and operator's labor) on these farms ranged from $1,252 to $8,836 per farm in 1942, and averaged $4,967. This was an increase of $2,468 over the average net earnings of the same farms in 1941. Higher prices and greater production of crops and livestock increased average total farm receipts from $4,803.63 in 1941 to $8,343.76 per farm in 1942.

Average farm expenses at the same time increased from $2,303.72 in 1942 to $3,376.23 per farm in 1942.

Grain and fat stock furnished the major source of income. Corn acreage changed from an average of 49 acres per farm to 63 acres, and average production of corn rose from 2,018 bushels per farm in 1941 to 3,704 bushels in 1942, an increase of 83 percent. Hog sales per farm were increased from 22,380 pounds average in 1941 to 27,570 pounds in 1942; total pork production (including home-butchered hogs) increased 32 percent in 1942 over 1941. Beef cattle production was about 20,000 pounds per farm average in each year. Average egg sales increased 26 percent, from 389 dozen per farm in 1941 to 490 dozen per farm in 1942.

Of the expenses, hired labor and machinery expense each accounted for about 20 percent of the total expenses, and feeds bought represented about 17 percent of the total expense, even though this is an important feed producing area.

The 10 more profitable farms were larger than the others, had higher yields of corn, and a larger proportion of harvested crops fed to livestock. Greater intensity of cropping and livestock production linked with more efficient handling of livestock on the more successful farms is evident by an average total income of $45.19 for each tillable acre on those farms as compared with an average of $38.88 on the 25 farms.

Expenses per tillable acre on the 10 more profitable farms were about the same as on all the farms but receipts were larger. Receipts from hogs were greater by $4.00 per tillable acre on the more profitable farms than on the average for the 25 farms, and receipts from beef cattle were $3.00 greater per tillable acre. Thus, greater intensity of crops and livestock, more efficient handling of crops and livestock and larger farms resulted in approximately $2,000 more in operator's earnings per farm for the 10 more profitable farms than for the average of the 25 farms.

Trends in Kentucky farm-land values.— Land values in Kentucky have fluctuated greatly since the period preceding World War I, averaging about $22 per acre in 1910, $60 in 1920, $43 in 1925, $44 in 1930, $30 in 1935, and $38 in 1940. Increasing prominence of burley tobacco development of all-weather automobile roads, and improved school facilities in rural areas have been important factors associated with the higher valuations in 1935 and 1940 than in 1910. The highest percentage increases in value per acre were in the central, south central and eastern parts of the state.

The period from 1925 to 1930 probably was the most stable period for Kentucky land values in recent years, average valuations were about 16 percent lower in 1940 than in 1930. Since 1940, however, values have increased, rising by October 1943 some 10 to 25 percent in various parts of the state over 1940 values. Land transfers also have been 20 to 50 percent more numerous. Highest percentage increases in value have occurred in those areas where land values were relatively low, or near industrial areas. The purchasers of farm land were principally farm owner operators. Up to the end of 1943 very little land speculation had occurred.

Simplification of farm labor practices.— The Department of Farm Economics and the section of Agricultural Engineering of the Experiment Station are collaborating in this project, which involves making time and motion studies of farm laborers and equipment in action on selected farms, in an attempt to discover the best methods for doing various farm jobs, to eliminate waste effort, and improve accomplishment per worker.

Workers differ greatly in the amount of work they get done under substantially the same conditions. Some farmers use as much as 38 man-hours per acre in gathering corn, while others get the job done with only 2 man-hours per acre. Some operators strip 407 pounds of tobacco per day; others only 25 pounds. These differences are mainly due to differences in the techniques and equipment used. By use of time and motion studies of various operations in hay harvesting, tobacco pulling, setting, cutting, housing, and stripping, and in certain other operations, increases of 25 to 75 percent in the output per hour and per worker were attained. The coordination of tobacco cutting and housing crews was also studied intensively to discover how best to coordinate the movements of crew members so as to avoid unnecessary delays, loss of time and motion, and to secure the maximum accomplishment of the crew. Because of faulty organization and methods used, one crew was wasting 75 percent of its total time. Some crews had succeeded in eliminating nearly all avoidable lost motion.

Farm labor: demand and supply.— Data on the labor requirements of each crop and livestock enterprise were gathered and made available early in the year, and were used throughout the state to help farmers arrange their crop and livestock systems so as to avoid or minimize, so far as possible, the peak labor periods; to forecast periods during which seasonal labor would have to be used, and to calculate the amount of such labor that would be required. The demand for farm labor and the sources of its supply were investigated by farm-to-

farm surveys in four of the type-of-farming areas of the state. On 82 representative farms in Central Kentucky about 35 percent of the total labor used was spent on livestock. Burley tobacco required nearly three-fourths of all the labor used on crops. Peak labor periods came in May, June, and July at the time of breaking and fitting land for crops, setting tobacco, and harvesting hay and small grain; in the last half of August and first half of September at time of cutting and housing tobacco; and in October and November at time of harvesting hay and corn, filling silos, seeding small grain, and stripping tobacco. Much extra day labor is needed at these peak seasons, and the extra workers are sought in the local villages and towns, on neighboring farms having more workers than needed at the particular time, and outside the area—principally from the eastern and southern parts of the state.

On 150 representative farms in the Pennyroyal area about 40 percent of the total labor used is spent on livestock, fairly well distributed through the year. Work on crops is highly seasonal with labor peaks in May, September, and November, when a large amount of extra day labor is needed. Workers are sought on nearby farms, in local towns and villages, and more recently in the northern parts of the four counties surveyed and at the Internment Camp for war prisoners at Camp Campbell.

In the Lower Ohio Valley area, on 145 representative farms, extra day labor is needed chiefly for harvesting crops. Workers are sought on nearby farms, in local towns, and recently at the Internment Camp for war prisoners at Camp Breckinridge. Need for extra seasonal labor was greater in the bottomland areas than on the rolling land of the area. Some of the extra labor needed on the overflow and gently rolling lands can be obtained from the nearby rolling and hilly areas, though the bulk of it must be obtained elsewhere.

In Eastern Kentucky 355 representative farm families in 5 counties were interviewed. It is in this area that there has been thought to be a considerable surplus of labor available for work elsewhere. As of December 1, 1942, migration of workers from the area already had been heavy. Of the heads of families remaining, 35 percent were already productively employed, 30 percent were classifled as not able to work elsewhere, and 35 percent were estimated to be "potentially available for employment elsewhere." It should be emphasized, however, that the latter estimate would apply only if a 100-percent recruitment were assumed. Most of the workers who had left had gone into industrial employment, at higher wages than farm labor generally

commands. Of those remaining who might be induced to leave the area probably only a small percentage would elect to work on farms. Practically all of the heads of families interviewed were familiar with work in crops and in the care of livestock. Only a few had used power machinery.

The periods of the year during which the people on farms in Eastern Kentucky are most available for seasonal work elsewhere are principally July, August, and October.

Farm wages in Kentucky.— With large numbers of farm workers going into nonfarming employment, problems arise as to comparative pay for farm and nonfarm work and the wages farmers can afford to pay. Information on these questions was obtained from farm employers and laborers in the principal commercial farming areas of the state. In general, the average daily cash wage of "year" farm hands in Kentucky has increased 50 to 100 percent during the past 5 years, with greatest increase in the Lower Ohio Valley and the Purchase area. Noncash remuneration furnished farm laborers (such as dwelling, meat, poultry, eggs, and garden) when valued at farm prices, amounted to about $1 per day. At city consumer prices these items might very reasonably amount to $2 to $5 per day.

In terms of the cash value of major farm products, a smaller quantity of farm products, in general, was required to purchase a day of work in 1942 than on the average in the period 1939-1942.

Exchange and custom use of farm machinery.— In a study of usual custom charges in counties and type-of-farming areas for farm jobs and the use of farm machines, it was found that many farmers have not made full use of their machinery. For example, some tractors in Christian, Henderson, Todd and Union counties were being used less than 10 days per year; only a few were used 100 days per year, and the average was less than 50 days per year. Many such implements as combines, hay balers, and corn pickers are idle many days when they might be in use. By increasing the use of such equipment through exchange or custom work the unit-cost of using the machine is greatly reduced.

Transportation of farm and food products.— The organization for marketing farm products has been built around transportation facilities which make possible the movement of commodities from regions where natural conditions favor their production to regions of dense population for processing and consumption. By and large, farm products start their journey to market as the small surpluses of many

farms, assembled at country points in sufficient quantities to justify shipment to distant processing plants or consuming centers. Transportation requirements thus are of two main types: (1) transportation for local assembly, and (2) transportation from local assembly points to processing plants or consuming centers.

Transportation requirements in a diversified farming area of comparatively small farms differ materially from the requirements in an area that specializes in production. Collection of milk from farms in the Louisville area, for example, where herds are comparatively large and a large proportion of farms have milk cows, requires different transportation facilities from those required in sections where only a few cows per farm are kept and few farms sell milk. In the Purchase area the average number of cows kept on farms producing milk was only 2.6. Sales averaged only 1,750 pounds of milk yearly, per farm, while farms selling butterfat sold an average of 301 pounds. In another area, consisting of 18 counties in the western part of the state, milk was sold from only 6.7 percent of the farms and cream from only 38 percent. This makes the unit picked up per mile of truck operation very small.

Seasonal differences in the requirements for transportation vary widely. Some crops, such as tobacco, require transportation only during a short period of the year. Others, like livestock, require transportation facilities occasionally throughout the year, while still others, like milk, require use of facilities daily throughout the year. Even in transportation of milk, however, requirements vary greatly from season to season. Milk deliveries in the Purchase area, for example, were 225 percent larger in June than in November; while in the Louisville area deliveries of Grade B milk were 57 percent greater in June, 1943 than in November, 1942. Thus, in order to have facilities to handle loads at peak seasons, there is considerable unused capacity during much of the year.

The free choice of markets together with the free choice of market days, has resulted in much overlapping of routes or unnecessary mileage in the collection of farm products from the farm. As many as five cream collection routes traveled some roads in the Purchase area. In the eight counties, by eliminating all overlapping of routes, 52,530 miles, or 33 percent of the total mileage, could have been saved.

Changes in the seasonal pattern of tobacco sales.— Three rather distinct sale patterns have existed on Kentucky markets since the pioneer years of tobacco production. Before 1830, tobacco receipts at the Louisville Inspection Port increased rapidly during spring,

reached a peak in May, and declined rapidly. This pattern was determined largely by the character of river transportation, the only practical means of transportation available to pioneer tobacco shippers. In the next 50 years, to about 1880, tobacco sales on the Louisville hogshead market came to have practically no seasonal variation except for a slight increase in the fall, an adjustment due very largely to a gradual reorganization of marketing facilities and services. More recently, the seasonal pattern of sales was reversed, with the peak coming early and the season shortened materially. In recent years practically the entire crop of Kentucky tobacco has been marketed in a season ranging from 10 to 20 weeks. This increased seasonality in tobacco sales is explained in part by (1) the decentralization of selling, as manufacturers bought their requirements at local markets nearer centers of production; (2) production of a thinner, lighter-colored tobacco which is sold earlier to prevent depreciation in quality, and (3) decline of the market price-level near the end of the season, with resulting encouragement to producers to sell early.

Turkey prices and demand.— During the last 15 or 20 years, more and larger turkeys have been grown in the United States and the total amount of turkey meat available in 1942 was about 2⅓ times that of 1924. As population also has increased, the supply of turkey meat per capita about doubled during this period. At the same time, demand for turkeys has increased materially. Though prices have been affected considerably by short-run changes in number of turkeys, over the longer period, prices were reduced less than half when production per capita doubled. Consumption apparently was increased both through lower prices and through stimulated demand which resulted in consumers buying more turkey even at the same price. When demand became established at successively higher levels, however, it appears to have been relatively more inelastic.

Marketing turkeys in Kentucky.— Kentucky turkeys are sold by farmers to dealers who buy for resale in many widely separated cities. Each lot may be sold to a different buyer, whose requirements as to the amount of service, the quality of the product, and the type of market outlet may differ greatly. As a result, prices established by bargaining between growers and individual buyers tend to vary widely: from a fraction of a cent to nearly 7 cents per pound in different communities and in different parts of the state. In some instances the variations could be explained by differences in quality or marketing costs, but more often they occurred because of: (1) imperfections in competition associated with bargaining for a limited volume of

product, or (2) speculation resulting from uncertainty of supply and demand. These points are of great significance to those interested in a more stable market for turkeys. Moreover, despite the wide variation of prices within the state, average prices showed a consistent relationship to the average price in the United States during the last three decades.

The outstanding developments outside the state which have affected turkey marketing in Kentucky include a rapid expansion in production generally, a trend toward greater regional specialization, the appearance of new and important supply areas near large cities and consuming centers, improved methods of handling, and lower marketing costs in areas of concentrated production.

LIVESTOCK

Feeding, Management, Diseases

Digestible nutrients in bluegrass-molasses, alfalfa-molasses, and corn silages.— Bluegrass-molasses silage made from mature, weedy, dry Kentucky bluegrass with 45 pounds of blackstrap molasses per ton, alfalfa-molasses silage made from properly wilted one-tenth-bloom first cutting alfalfa with 45 pounds of molasses, and normal heavily-eared corn silage were each fed to the same 800-pound yearling Hereford feeder steers in consecutive digestion trials each consisting of a 5-day preliminary period and an 8-day collection period. Daily dry-matter intake was held at 10 pounds in all trials and no feed other than the silage being tested was given.

The results showed that the low-grade bluegrass-molasses silage contained only 6.0 percent digestible crude protein, 58.5 percent total digestible nutrients, and had a nutritive ratio of 1:8.8; the excellent alfalfa-molasses silage contained 13.7 percent digestible crude protein, 61.1 percent total digestible nutrients and had a nutritive ratio of 1:3.5; the excellent corn silage contained 4.5 percent digestible crude protein, 69.9 percent total digestible nutrients and had a nutritive ratio of 1:14.5, all percentages calculated on water-free materials.

Similar digestion trials were completed with 550-pound yearling Hereford feeder steers fed 7 pounds of dry matter daily in all trials. The silages for this series of digestion trials were made from early-bloom Kentucky bluegrass, containing about 25 percent white clover by weight, with 46 pounds of blackstrap molasses per ton; one-tenth-bloom alfalfa with 54 pounds of molasses per ton; and heavily eared

corn. The results showed that this excellent bluegrass-molasses silage contained 15.3 percent digestible crude protein, 75.2 percent total digestible nutrients and had a nutritive ratio of 1:3.9; the excellent alfalfa-molasses silage contained 13.0 percent digestible crude protein, 65.3 percent total digestible nutrients and had a nutritive ratio of 1:4.0; the excellent corn silage contained 4.5 percent digestible crude protein, 74.7 percent total digestible nutrients and had a nutritive ratio of 1:15.6, all percentages calculated on water-free materials.

Bluegrass-molasses silage versus alfalfa-molasses silage as roughage for steers in drylot.— Two similar lots of 10 choice western Hereford yearling steers were fed for 154 days in drylot. Steers in both lots received an average of 4 pounds of coarse, weedy, first-cutting alfalfa hay and 13.2 pounds of U.S. No. 2 yellow shelled corn per steer per day. In addition, Lot 1 was fed daily an average of 15.7 pounds per steer of alfalfa-molasses silage made from alfalfa cut when just coming into bloom, wilted until its dry-matter content reached 32 percent, and ensiled with the addition of 54 pounds of blackstrap molasses per ton of forage. Lot 2 was fed daily, in addition to the shelled corn and alfalfa hay, an average of 15.5 pounds per steer of bluegrass-molasses silage made from full-bloom Kentucky bluegrass containing a small percentage of white clover, wilted, and ensiled with the addition of 50 pounds of blackstrap molasses per ton of forage. Lot 2 received a total of 1.9 percent less dry matter in its silage than Lot 1. Salt, ground limestone, and fresh water were available to both lots at all times.

The steers that received alfalfa silage gained an average of 2.25 pounds per steer per day, dressed 60.67 percent and graded "U.S. Choice." Those fed bluegrass silage made an average daily gain of 2.02 pounds per steer, dressed 59.03 percent and graded "U.S. Good plus." Poor gains made by two unthrifty steers in Lot 2 may have caused much if not all of the poorer showing made by the steers fed bluegrass silage.

Reid's Yellow Dent versus U.S.13 yellow hybrid for fattening steers in drylot.— Two closely comparable lots of 14 choice long-yearling Hereford steers each were fed for 118 days in drylot. The steers in Lot 1 received an average daily ration of 14.57 pounds of Reid's Yellow Dent shelled corn, 0.92 pound of soybean oilmeal, 14.68 pounds of rather immature corn silage, and 3.98 pounds of "U.S. No. 1 extra leafy" alfalfa hay. The steers in Lot 2 received exactly the same average daily ration except that their corn was U.S.13

yellow hybrid. The U.S.13 corn did not appear to be quite as well filled or mature as the Reid's Yellow Dent, although both corns graded low U.S. No. 2.

The steers in Lot 1 gained an average of 2.07 pounds per steer per day, dressed 60.1 percent and graded "U.S. Good plus." Those in Lot 2 gained 1.95 pounds per steer per day, dressed 60.4 percent and graded "U.S. Choice Minus." The difference in average carcass grade between the two lots was attributed by the official grader to brighter color and more marbling in Lot 2. Such a difference, if actually present, could hardly have been due to the difference in the rations. The difference in average daily gain cannot be considered significant.

Forage consumption of grazing steers.— A total of 43 digestion-consumption trials have been completed on Rosen rye, Balbo rye, winter wheat, Kentucky No. 1 barley, Italian ryegrass, Kentucky bluegrass, and Korean lespedeza in various stages of maturity, with yearling Hereford steers in feeder flesh and ranging in weight from 481 to 794 pounds. Intake of dry matter per hundred pounds live weight per day ranged from 4.35 pounds when grazing on 15-inch Italian ryegrass to 1.32 pounds for a steer grazing shoulder-high Rosen rye in the early dough stage. Only 61.50 percent of the dry matter in the latter forage was digested by the steer whereas 80.26 percent of the dry matter from this variety of rye when 18 inches high and tender was digestible. Balbo rye just heading out was found to be somewhat more digestible than Rosen rye in the same stage of maturity. No difference in dry matter intake was noted.

Salmonella abortivo-equinus vaccine for mares.— During 1943, enough vaccine to immunize 1,498 mares on 42 farms, was prepared and distributed by the Animal Husbandry Department. Reports indicate that this vaccine is nearly 100 percent effective.

Bovine parasitism.— In 20 herds of cattle, stomach worm infestation was responsible for death losses and debility. This was the cause of loss in 20 percent of all the herds studied. Seventy-five percent of the losses from stomach worms occurred during January, February, and March. The seasonal occurrence of parasitism in cattle differs from the incidence of parasitism in sheep because cattle are usually infested with a differnt parasite, *Ostertagia ostertagia,* instead of *Haemonchus contortus,* the common stomach worm of sheep. *Ostertagia* was mainly responsible for the losses occurring among cattle in winter and early spring. Bovine losses resulting from infestation with *H. contortus* occurred on three farms during July and August.

Distiller's wheat slop for pigs.— For a 48-day period, 3 lots of

ten 55-pound pigs were fed distillery slop produced in making alcohol from wheat. Lot 1 was full-fed settled slop (prepared by settling thin slop for 24 hours in barrels and throwing away the thinner upper half) and self-fed mineral composed of 4 parts ground limestone and 1 part salt. Lot 2 was self-fed U.S. No. 2 yellow shelled corn, tankage, the same mineral mixture as Lot 1, and all the settled slop they would drink. No water was given because previous experience indicated that much less slop would have been consumed if water had been furnished. Lot 3 received corn, tankage, and mineral mixture, self-fed.

The pigs in Lot 1 made an average daily gain of 0.70 pounds, and required 476 gallons of slop and 9.2 pounds of mineral per 100 pounds of gain. Lot 2 gained 1.35 pounds per pig per day, and required 108 gallons of slop, 217.0 pounds of corn, 36.0 pounds of tankage, and 1 pound of mineral per 100 pounds of gain. Lot 3 gained 1.16 pounds daily per pig, producing 100 pounds gain on 234.0 pounds of corn, 45.4 pounds of tankage and 1.4 pounds of mineral.

At the close of the slop-feeding period all lots were self-fed corn, tankage and mineral mixture for an additional 44 days, during which period the average daily gains for lots 1, 2, and 3 were 1.77, 1.85, and 1.73 pounds respectively, and the feed requirements per 100 pounds gain were: corn, 244.5, 273.0, and 270.0 pounds; tankage, 28.0, 22.0, and 29.0 pounds; mineral mixture, 0.9, 0.4, and 0.5 pounds, respectively.

Each 50-gallon barrel of settled slop fed to Lot 1 saved 24.6 pounds of corn and 4.8 pounds of tankage but required 0.8 pounds more mineral. As fed to Lot 2, each 50-gallon barrel of settled slop saved 7.9 pounds of corn, 4.4 pounds of tankage, and 0.2 pounds of mineral. Valuing corn at $1.32 per bushel, tankage at $85 per ton, and the mineral mixture at $0.01 per pound, and disregarding the quality of the gains produced, each barrel of the settled slop was worth $0.78 as fed to Lot 1 or $0.37 as fed to Lot 2.

Botulism in swine.— Sporadic cases of botulism in 8 herds were investigated, as compared with 5 in 1942. The disease caused several deaths in each herd and numerous other hogs in the same herds were showing severe symptoms. The source of the toxin in 7 of the 13 cases was kitchen slop which contained spoiled canned food. Canned corn was the food involved three times; canned peas, twice, and canned green beans, twice. One outbreak occurred in a herd receiving restaurant garbage, and one resulted from hogs feeding upon cadaveric meat. In four cases the source of the toxin was not determined.

Nutritional deficiencies in swine.— Hogs from 258 herds were submitted to the laboratory for analysis and study. In 40 herds the actual cause of sickness and death was found to be malnutrition. All the animals in this group were carefully inspected at post-mortem for lesions of infectious disease, and bacteriological examination was made. No evidence of an infectious disease was found, either by the presence of lesions in the organs or by demonstration of infectious agents in the tissues. The presence of the virus of hog cholera was largely eliminated since all but one of the herds consisted of immunized animals, and although the sows in the herd later mentioned were non-immune to hog cholera and 50 shoats in the same herd were also non-immune, none showed any evidence of sickness at the time, or later.

Taking the feed into consideration, in the majority of cases there was a deficiency of vitamin A and calcium. Some herds were receiving too little total feed, and others too little protein. These feed deficiencies occurred principally in herds being fed wheat or distillery slop in drylot. In a few cases, the hogs receiving either wheat or distillery slop were running on pasture, but the pasture was very poor. Thus, considering the losses which occurred, the failure of pigs to develop properly, the condition of the tissues at autopsy, and the kind and source of the feed, it seems quite evident that the hogs were undernourished and that the various difficulties could have been prevented.

Lack of vitamin A and animal protein was strikingly shown in the pigs of 10 brood sows that farrowed in September and had been on bluegrass pasture and ground wheat throughout the summer and after farrowing. An unusually large number of pigs were born dead or died at birth. Only 51 pigs lived to nurse, and only 25 were alive after 3 weeks. The only lesions found on post-mortem examination were a mild enteritis. Nearly all the 26 pigs that died were undersize for their ages, thin in flesh and anemic, with wrinkled skin and rough hair. One sick pig, removed from the herd and fed whole (cow's) milk plus cod-liver oil made a rapid and complete recovery. Throughout the period the sows were in good flesh and seemingly healthy, yet their milk did not nourish the pigs. When the sows' feed was changed to yellow corn and tankage, no further losses occurred among the nursing pigs and all soon were in normal health.

Early vs. *late cutting of Korean lespedeza for dairy cows.*— Three digestion trials were made during the winter of 1943, using two Jersey and two Holstein cows of the Experiment Station herd.

The first trial was with Korean lespedeza hay cut just before bloom on August 10, 1942; the second with hay from the same field cut on September 10 while in a medium-bloom stage, and the third was with hay from the same field cut on October 9 when the crop was in seed stage. The two earlier cuttings were more palatable to the cows than the hay cut in the seed stage. Though, by chemical analysis, the later-cut hay had most protein (16.4, 16.9, and 19.7 percent, respectively, for early, medium, and late cuttings) and correspondingly less ash, ether extract, and nitrogen-free extract, the nutrients became less digestible as the crop matured. The total digestible nutrients for three samples of hay were: early cut (pre-bloom stage), 54.7 percent; medium cut (early to full bloom stage), 49.5 percent; and late cut (seed stage) 42.3 percent. On this basis, Korean lespedeza hay cut early is about one-third more valuable than hay in the same field cut during the seed stage.

Reproductive efficiency and milk production in dairy cows.— In a correlation of breeding records and butterfat production during a period of twenty-six years in the Experiment Station dairy herd, the cows that produced the most butterfat per year were found to be those that came nearest to producing a calf per year, per cow. The percentage reproductive efficiency of each cow was calculated by dividing 12 by her average number of months interval between calving dates during her lifetime in the herd. A cow was therefore 100 percent efficient as a breeder when she produced a calf for each twelve months of her life in the herd after her first breeding. The relation between reproductive efficiency and butterfat production was as follows:

Lifetime Breeding Efficiency	*Average Yearly Butterfat Production, pounds*
40 to 49 percent	264
50 to 59 percent	283
60 to 69 percent	284
70 to 79 percent	288
80 to 89 percent	307
90 to 99 percent	317

Alternate vs. continuous grazing of permanent pastures by dairy heifers.— Although the pasture season of 1943 was unusually short (168 days) due to drouth during late summer, greater-than-average gains were recorded on both the alternately and continuously grazed experimental pastures. No advantage was noted in favor of either pasturing practice during 1943. Each yielded at the rate of 350

pounds of gain per acre. During the past 8 years the average has been 309 and 294 pounds respectively for the alternately and continuously grazed pastures, and advantage amounting to 5.1 percent for grazing alternately.

Parasitism of ewes in winter.— A survey of the records on sheep mortality due to internal parasites shows a recurring seasonal incidence of the disease. Death losses in ewes are few except in late winter. The number of deaths begins to rise in January, reaching the highest point in March. When adult sheep are placed on spring pasture there is a precipitous fall in the number of cases of parasitism. These winter losses are associated with several direct and contributing factors which, along with the parasitic infestation, lowers the vitality and resistance of the animal. Among these are underfeeding, feeding unbalanced rations, feeds of poor quality, improper housing, lack of salt and, in some cases, an insufficient supply of water. The parasites found in these ewes are not acquired during the winter feeding period but during the previous gazing season. Such losses in ewes are actually due to a combination of parasitism and malnutrition. These losses can be prevented by anthelmintic treatment in the late fall and early winter, and by adequate feeding and care during the winter.

Silage versus alfalfa hay for pregnant ewes.— Four comparable lots of 10 pregnant western ewes were fed for 168 days in drylot. Each ewe in three of the lots was fed a daily ration composed of 1.6 pounds of U. S. No. 2 alfalfa hay and enough of either alfalfa-molasses, bluegrass-molasses, or corn silage to supply 1.6 pounds of dry matter per ewe. In addition, each ewe in the lot receiving corn silage also received 0.2 pound of soybean oilmeal per day. Those in the alfalfa and bluegrass silage lots received 0.7 pound of yellow shelled corn per ewe daily. Each ewe in the fourth lot was fed 3.2 pounds of the alfalfa hay and 0.7 pound of the yellow shelled corn per day. All ewes had free access to fresh water, ground limestone, steamed bonemeal, and salt.

An evaluation of these four roughages for wintering pregnant ewes (if based on final condition of ewe, weight of fleece, birth weight of lambs, and 28-day weight of lambs) would rank them in the following descending order: alfalfa silage, alfalfa hay, bluegrass silage, and corn silage. The bluegrass silage used in this test was below average in quality.

Grain rations for creep-fed suckling lambs.— Suckling lambs creep-fed to about one month of age on a mixture composed of 6

parts ground yellow shelled corn, 3 parts crushed oats, and 1 part pea-size linseed meal, and then, for the next three months, creep-fed only cracked yellow shelled corn, gained slightly faster, dressed one full grade higher, and produced each pound of their gains on 14 percent less fed than did a similar group of lambs creep-fed the above grain mixture throughout the entire 4-month period.

In each of four previous tests lambs fed cracked yellow shelled corn throughout the entire 4-month period made faster gains on less feed and produced higher-grading carcasses than comparable lambs creep-fed the more costly grain mixture.

Continuous versus rotational grazing of bluegrass pasture for unweaned spring lambs.— Of eight tests that have been completed in this series, six have favored a system of rotational grazing in which ewes and their lambs are moved to a fresh third of their Kentucky bluegrass pasture every two weeks, as compared with similar lots of ewes and lambs grazing an equal acreage of bluegrass continuously. The average difference in favor of rotational grazing is 5.2 percent for the eight tests. In the latest of these tests, conducted in 1943, the group grazing rotationally outgained the group grazing continuously by 13.5 percent.

Barn feeding versus grazing for late lambs.— Twenty-four late lambs were divided into three comparable lots of 8 lambs each. Two of the lots grazed 2-acre fields of average bluegrass for the experimental period of July 16 to October 22. The third lot was confined to drylot and full-fed yellow shelled corn and U. S. No. 1 third-cutting alfalfa hay, consuming a daily average of 1.29 pounds of corn and 1.20 pounds of hay. The two lots on bluegrass pasture made average daily gains of 0.289 and 0.298 pound, dressed 44.7 and 46.6 percent, and yielded carcasses of "U. S. Choice minus" average grade. The drylot lambs gained 0.326 pound per lamb per day, dressed 48.8 percent and graded "U. S. Choice." These late lambs made very acceptable gains and carcasses on average permanent bluegrass pastures even during a drouthy fall, when kept free from internal parasites.

Effect of shearing on gains and market quality of late lambs.— Twenty-four late lambs were separated into two closely comparable groups of 12 lambs each. One lot was sheared on July 16 and the second lot was left unsheared. In all other respects the two groups received the same treatment. When marketed, October 22, the sheared lambs had gained 16 percent more, dressed 3.4 percent more, and graded slightly higher than the lambs not sheared. They yielded 1.6 pounds of wool each in July and all produced No. 1 shearling pelts.

Fourteen additional lambs were separated into two comparable groups of 7 lambs each. One of these groups was sheared on July 29. Otherwise the two groups received the same treatment until October 22. This sheared group outgained their unsheared checks by 14.0 percent while dressing the same and grading very slightly higher. They yielded average fleeces of 2.5 pounds in July, and all produced No. 1 shearling pelts.

Phenothiazine-salt mixture for late lambs on pasture.— Two closely comparable lots of 8 late lambs were grazed from July 16 to October 22, a period of 98 days, on similar halves of a 4-acre bluegrass pasture that subsequently was proved to be practically free from nodular-worm and tapeworm infestation. One lot of lambs was given a standard drench of the cunic mixture every three weeks, whereas the other was not given the cunic mixture but was allowed free access to a 9:1 mixture of salt and phenothiazine. The lambs receiving the cunic drench gained an average of 0.30 pound per head daily, dressed 46.6 percent, and graded "U. S. Choice minus." Those receiving the salt-phenothiazine mixture gained 0.29 pound per head daily, dressed 46.6 percent, and graded "U. S. Choice minus." No appreciable degree of parasitism was noted in either group at time of slaughter. As nodular worm infestation was not heavy on the pasture (the cunic mixture is known to be ineffective against nodular worms, and had the pasture been badly infested the lot of lambs receiving the cunic mixture also would have been badly infested), no comparison of the true worth of the two treatments was possible. Nevertheless, the experiment was of value in demonstrating that (1) the salt-phenothiazine mixture had no adverse effect on rate of gain, and (2) it apparently controlled the common stomach worm effectively.

Effectiveness of fused rock phosphate and other phosphates for chicks.— Two feeding experiments of 8 weeks each were completed to determine the comparative values of several mineral substances as supplemental sources of phosphorus in an all-mash ration for chicks. Rations for growing chicks containing protein derived largely from vegetable sources did not produce normal ash content of the bones or normal growth unless supplemented with a satisfactory source of phosphorus. Fused rock phosphate containing 0.01 percent of fluorine and that containing 0.3 percent were equally effective in supplying phosphorus for growing chicks, and either was as satisfactory as bonemeal. No harmful effects of fluorine were observed from feeding fused rock phosphate containing 0.3 percent fluorine, or less, at levels up to 3 percent of the total ration. However, 3 per-

cent of raw rock phosphate analyzing 3.42 percent fluorine in the ration of growing chicks decreased feed consumption and retarded growth. Results with calcium metaphosphate as a supplement were not consistent; a lower ash content of the bones was noted.

Vegetable versus animal protein for growing pullets.— For the second year, at the Experiment Station farm, pullets 10 to 12 weeks of age were transferred from the brooder house to green pasture and fed as follows:

Range 1: Hopper-fed yellow corn and meat scrap with 2 percent salt added. Water.

Range 2: Hopper-fed yellow corn, meat scrap with 2 percent salt added, soybean oilmeal with 2 percent salt added, and steamed bonemeal. Water.

Range 3: Hopper-fed yellow corn, soybean oilmeal with 2 percent salt added, and steamed bonemeal. Water.

The pullets when housed showed an equal degree of maturity, and only slight differences in production were noted during the first three months of the laying year.

A similar experiment at the Western Kentucky Substation included two broods each of Barred Plymouth Rocks and New Hampshires, each allowed range when 6 weeks of age. When the chicks were allowed pasture they were fed as follows:

Brood 1: Hopper-fed yellow corn, wheat, and meat scrap with 2 percent salt added.

Brood 2: Hopper-fed yellow corn, wheat, soybean oilmeal with 2 percent salt added, and steamed bonemeal.

In this experiment also there were no significant differences in the weight of the pullets either at 12 or at 22 weeks. In both experiments economical growth was obtained on the vegetable protein properly supplemented with green pasture and steamed bonemeal.

Appetites of hens for bluegrass forage.— Rhode Island Red yearling hens in laying houses and all receiving the same all-mash laying ration, were given access to a bluegrass pasture August 21, 1943. Six weeks later the hens were weighed, killed, and their gizzards removed for examination. The contents of the gizzards after drying were weighed and examined microscopically. Twenty-five percent of the gizzards contained no grass, 17 percent contained about 98 percent grass, while the remaining 58 percent contained amounts of grass ranging from 25 to 65 percent of the total contents of the gizzard. Some of the hens evidently did not crave grass or had not become accustomed to eating it; others, whose gizzards contained 98 percent grass, must have had a distinct craving for it, as the mash was before

them at all times. The large number in the range of 25 to 65 percent of grass in the contents of their gizzards probably were the normal.

Simplified methods of feeding growing and laying pullets.— This experiment which included a comparison of the cafeteria method and the mash and grain method of feeding was continued at the Robinson Substation. Both broods were fed a well-balanced mash for four weeks. The first brood was then given grain and mash. The second brood was fed a cafeteria-type ration which consisted of yellow corn with 1 percent of cod-liver oil added, meat scrap with 2 percent of salt added, and soybean oilmeal, all in hoppers, and lespedeza hay fed in racks. The pullets raised in the two broods were continued on the same feed during the laying year. The results for the year were:

	Average Egg Production	
	Barred Rocks	*R. I. Reds*
Hopper-fed mash and grain	163	133
Cafeteria fed	143	141

As in the previous year's experiment there was a difference in the response of the two breeds. Either of these methods is adapted to farm use, since both are time-saving and economical.

Hydrogen-ion concentration of digestive tract of chickens.— The hydrogen-ion concentration of the mucosa and the contents of different parts of the alimentary system and of the liver, pancreas, bile, and abdominal and subcutaneous depot fats of 1- and 2-year-old White Leghorn and Rhode Island Red cockerels, actively laying and molting hens, and hens that had never laid was determined colorimetrically. The findings were the same for the two breeds and the two ages. In another experiment, in which the same ration supplemented with 2-percent or 5-percent bonemeal was used there was no difference in the findings for the parts considered except a slightly higher hydrogen-ion concentration in the crop, proventriculus, and gizzard of the chickens receiving bonemeal. The hydrogen-ion concentration in the remaining parts of the digestive tract remained unchanged.

Poultry diseases.— Causes of sickness and death among chickens were studied by pathological and bacteriological methods in about 400 flocks. Preventable common diseases and nutritional disorders were found to cause the greater part of poultry mortality. In the flocks from which birds were received for examination, 69 percent of the disease problems resulted from four conditions: pullorum disease, 22 percent; coccidiosis, 22 percent; internal parasites, 13 percent; and

nutritional disorders, 12 percent. Reducing or eliminating losses due to any of these four conditions requires no expenditure for medication. Correct feeding and sanitary precautions will effectively control them. The avian leucosis complex accounted for 10 percent of the losses.

A group of 19 other disease conditions embraced 15 percent of the diseases recognized, while those birds in which the cause of trouble was not definitely determined comprised 6 percent of the total.

In the groups of flocks suffering from malnutrition (66 cases), there were 14 flocks deficient in vitamin A, 21 in vitamin D, 6 in vitamin E, and 16 in riboflavin. These were clear-cut clinical cases. In 9 flocks the rations were grossly inadequate, the birds being plainly undernourished. In addition to this group there were many flocks in which there was some clinical evidence of nutritional deficiency associated with bacterial or parasitic diseases.

Salmonella bacterial studies.— A total of 1,742 bacterial cultures possessing gross characteristics of the Salmonella group, from this and other laboratories in various parts of the United States and foreign countries, were examined, studied, and identified. Of these, 1,522 were found to be Salmonella and were identified serologically. The remaining 220 cultures were coliform bacilli of various kinds. Examination of the biochemical properties of these latter cultures eliminated them from the paratyphoid group.

Of the Salmonella cultures, 918 were isolated from domestic animals and 604 from man. The antigenic formulas of 4 new types were determined. These were as follows: *S. madelia* (I,VI,XIV,XXV:y-1,7 . . .), *S. florida,* (I,VI,XIV,XXV:d-1,7 . . .), *S. mississippi* (I,XIII, XXIII:b-1,5 . . .), and an unnamed type isolated in England (VI,VII: k-1,10 . . .). Furthermore, the antigenic formulas of 3 additional new types *(S. claibornei, S. pueris* and *S. infantis)* were confirmed for other workers. *S. gaminara, S. potsdam, S. carrau, S. stanley, S. kirkee, S. dar-es-salaam* and *S. coli I* were recognized for the first time in the United States. *S. gallinarum* and *S. abortus equi* were identified for the first time among cultures isolated from man. Ten additional cultures of *S. pullorum* from man were typed.

A group of coliform bacilli serologically related to *S. cerro* and *S. duesseldorf* were studied intensively. By correlation of epidemiological and serological data with pathogenicity tests it was possible to prove that these paracolon strains were primary agents of infection in young fowls.

In differentiating between the true *Salmonella* and closely related

forms, particularly those of the coliform group, it is absolutely necessary to have standard serums, which are essential reagents for identification. The typing of Salmonella, in turn, has a very direct relation to epidemiological studies and measures used in control of these infections.

A number of workers from other laboratories were instructed in antigenic identification of Salmonella cultures.

SOILS AND CROPS

Improvement of Kentucky bluegrass.— The program for improvement of Kentucky bluegrass has been expanded to include inoculation of plants with diseases that cause much damage to Kentucky bluegrass in Kentucky—*Helminthosporium* leafspot, stripe smut, leaf rust, *Septoria* culm rot, *Septoria* leafspot, and powdery mildew. Thirty-eight strains of bluegrass with good growth habits were tested in the greenhouse for reaction to two cultures of powdery mildew and one culture of *Helminthosporium* leafspot. Two strains were highly resistant to both mildew and leafspot, and four were highly resistant to mildew and fairly resistant to *Helminthosporium* leafspot. In all, about 15 percent of these strains were sufficiently resistant to the cultures of the two diseases. Obviously a large number of bluegrass strains must be tested to obtain a few that are reasonably resistant to the several diseases affecting bluegrass seriously in Kentucky.

Seven advanced hybrids between Kentucky and Texas bluegrasses, obtained from the Missouri Experiment Station, were tested for resistance to powdery mildew and *Helminthosporium* leafspot. Six were resistant to mildew, but all are very susceptible to *Helminthosporium*.

Orchard-grass.— Most of about 780 S_1 inbreds from 44 orchardgrass plants were found to be susceptible to disease. Serious diseases of orchard grass identified in Kentucky during the year were anthracnose, *Scolecotrichum* leaf stripe, *Stogonospora* leaf blotch, and stripe smut.

Meadow fescue.— A strain of what appears to be the variety of meadow fescue *Festuca elatior arundinacea* was found in cultivation in 1931 on a farm in east Kentucky to which it had been brought 40 years previously. This grass, designated as Ky. 31 meadow fescue, is a bunch grass and is characterized particularly by a robust growth of erect-to-decumbent leaves with generally wide, stiff to relaxed blades. Following satisfactory performance in tests, this grass was put into test-demonstrations throughout the state. Because of its wide soil

adaptability, drouth resistance, cold and heat resistance, good pasture qualities, and satisfactory seed habits, this grass promises to find a large place in Kentucky. In contrast to ordinary commercial fescue, which usually has not been satisfactory in Kentucky, Ky. 31 meadow fescue generally remains green and in good condition throughout the year and is resistant to crown rust and *Helminthosporium* net blotch.

Red-clover improvement.— In the field test, on 1/250 acre plots at Lexington, the Southern Selection, an improved variety being developed for the southern part of the red-clover region, produced at the rate of 4,754 pounds of hay per acre, and adapted Kentucky varieties 4,558 pounds. The Cumberland variety produced 3,932 pounds; Midland, adapted to the corn belt, produced 3,520 pounds; Minnesota and Canada clovers produced 2,631 pounds; and French, 114 pounds. Damage of stands by southern anthracnose perhaps was the principal cause of differences in yield.

The Southern selection made better recovery following the second crop than other adapted clovers.

Attempts to isolate self-fertile lines from the Southern selection were successful, about 15 being obtained. These and others that may be obtained will be top-crossed with superior self-sterile plants, and the progenies selfed. In this way, it is hoped to obtain disease-resistant inbreds and with them to develop a highly disease-resistant and high-producing variety of red clover.

Yield of hybrid and open-pollinated corn.— In addition to tests at the Station farm, 26 test demonstrations for comparing yields of hybrid and open-pollinated corn were made in 14 communities in 1943. The open-pollinated varieties were those regarded among the best in the communities where the tests were made, while the hybrids were Kentucky Experiment Station hybrids 72, 72B, 102, and 103, and U. S. 13. In nearly all these communities drouth prevailed during July and August, so that all yields were relatively low, averaging 41.0 bushels an acre for the hybrids and 31.2 bushels for open-pollinated. The hybrids yielded about 10 bushels more per acre than the open-pollinated, or 31.4 percent. In five of the demonstrations, however, the hybrids averaged over 60 percent more than the open-pollinated, and in only one test did the open-pollinated yield as much as the hybrid.

In the tests at the Station farm the average yield of all white hybrids was 78 bushels per acre. Rainfall was very deficient in August. In 1942, when rainfall was abundant at all times, the average was 115 bushels per acre. The ranking of the different hybrids differed greatly

in the two years: Ky. 72B ranked 39th in 1942; 2nd in 1943. In Tennessee No. 14 ranked high in 1942; relatively low in 1943. The yellow hybrid Ky. 103 ranked 55th in 1942; 8th in 1943; and U. S. 13 ranked last in 1942 but 21st in 1943. Several hybrids, however, were considerably above average in both these widely different seasons. These are probably the most dependable hybrids to use.

Hardiness of winter barley.— Winter-killing of small grains during the winter of 1942-43 was severe in Kentucky. In the barley winter-hardiness test 39 varieties were tested, among which were most of the recent introductions by experiment stations of the country and the U. S. Department of Agriculture, as well as the older well-established varieties. Of the older varieties, only Kentucky No. 1, Purdue 21, Reno (developed by the Kansas Experiment Station), and Kentucky Common Winter survived 100 percent; and Missouri Early Beardless, a rather widely grown variety, about 75 percent. A few new introductions also survived 100 percent, including Mercer, Kirwin, and a smooth-awned line from the Purdue Experiment Station. These hardier varieties, if planted at the proper time, are only slightly less hardy than the varieties of wheat commonly grown in Kentucky. Wong winter-killed 100 percent; Marnobarb 90 percent; and though very desirable from other standpoints, these varieties evidently are not dependable in Kentucky.

Hardiness of winter oats.— In a variety test including Winter Turf and the three Winter Fulghum varieties Fulwin, Tennex, and Forkadeer, all the varieties were killed by near-zero temperatures in January, February, and March when there was no snow protection. Winter Turf and Tennex were entirely dead by the first of March, and light stands of Fulwin and Forkadeer still surviving on March 1 were killed during a near-zero period in March. It seems clear that Fulwin and Forkadeer are considerably more winter-hardy than the old Turf, but they are not nearly so hardy as the common varieties of wheat grown in Kentucky or the common winter barley. The excellent survival of these Fulghum varieties in other years in Kentucky (they have been rather extensively grown in Kentucky during the past four or five years) has evidently been due chiefly to the fact that the winters were unusually mild and that during critically cold times there was no protection.

Effect of retting on chemical composition and strength of hemp fiber.— The chemical composition of hemp fiber was studied in order to learn more about the retting process and its relation to fiber strength. It was found that fiber from unretted hemp is about 70 per-

cent cellulose and lignin, which may be classed as the more insoluble fraction. The remaining 30 percent is composed of nitrogenous compounds, pectin, pentosans, extractives, and ash. This may be termed the partially soluble fraction. In dew retting, enough of the more soluble fraction is lost by weathering and the activity of microorganisms to increase the proportion of cullulose-lignin by about 10 percent. Retting also results in a great decrease of fiber strength. In these tests, the fiber had a breaking strength of 192.0 Kg unretted, and 117.4 Kg after retting. Leaving the hemp on the ground after retting was completed—that is, after the fiber separated easily from the stalk—caused rapid deterioration in strength of fiber because, with the depletion of the more soluble fractions, microorganisms begin to utilize the cellulose itself. It is highly important, then, that hemp be shocked or stacked as soon as sufficiently retted for satisfactory breaking.

Winter retting, as compared to fall retting, usually produces a fiber with better color but less strength.

A machine for beating out hemp seed.— For threshing the hemp seed grown in Kentucky in 1943, a machine suitable for use on the farm was planned and constructed. It consists of a box 8 feet wide, 16 feet long, and 1½ feet deep, mounted on skids or wheels to move it from shock to shock. Mounted on top of the sides of the box is a movable housing, supporting a 1½-inch iron-pipe shaft to which are fastened 12 lengths of trace chains, spaced 6½ inches apart. When the shaft is rotated at about 200 revolutions per minute, the chains flail the seed from the hemp plants placed on the floor of the bed. The beater may be operated by a 1½-horsepower gasoline engine or by a tractor through the power take-off.

Twenty-nine of these machines, at an average cost of $130, were built in 15 counties during 1943 and were used in harvesting over 2,000 acres of hemp seed. With the machine, 3 men were able to beat out 1 acre of hemp in 2 hours—a saving of 7 man-hours per acre over beating it out by hand on a canvas.

Castor beans.— Each of three varieties of castor beans (Conner, Doughty 11, and Kentucky 38) was planted at about 14-day intervals, beginning April 8. As an average, the acre-yields from the successive plantings were 1,353, 1,206, 1,004, 1,036, 581, and 66 pounds. The average yields for each variety were 929, 931, and 786 pounds per acre, respectively.

To determine relation of stand to yield, stands of each variety

were thinned to one, two, and three plants per hill in hills 42 by 42 inches. Yields of threshed seeds at the three rates of plants per acre were Conner variety, 1,349, 1,236, and 1,326 pounds per acre; Doughty 11, 1,301, 1,258, and 1,351 pounds per acre; and Ky. 38, 1,100, 1,187, and 1,359 pounds per acre. A new variety, Ky. 41, produced 1,119, 1,369, and 1,448 pounds, respectively.

In a fertilizer test at Lexington, with the Conner variety, 10 pounds of nitrogen per acre applied at the hill, with or without phosphate and potash, produced an average increase in yield of 120 pounds of threshed seeds per acre, above the 1,390-pound average yield of the plots receiving no nitrogen. Phosphate and potash fertilizers produced no increase in yield. In similar tests at the Princeton Substation none of the fertilizers increased the yield of seed.

Soil-fertility studies at outlying experiment fields.— The soil-fertility studies at the long-established fields near Berea, Fariston, Campbellsville, Greenville, and Mayfield were continued, although work at the Mayfield field was curtailed because of shortage of labor. Soil-management recommendations in line with the findings in these studies since the establishment of the fields between 1913 and 1919, have been extensively adopted in the state and have contributed materially toward higher crop yields and reaching wartime production goals.

The soils on which these experiments are conducted respond somewhat differently to treatment, but all have shown excellent response to limestone and phosphate in a cropping system which includes legumes and the return of manure equal to the weight of the crops removed except the wheat grain. In 1943, average acre-yields of the plots receiving limestone and superphosphate at the five fields, were: corn, 53 bushels; wheat, 25 bushels; mixed clover hay, 4,138 pounds; and second-year hay, 3,662 pounds. Corresponding yields for the plots receiving only manure were: corn, 21 bushels; wheat, 9 bushels; mixed clover hay, 1,734 pounds; and second-year hay, 1,770 pounds.

Greenhouse tests of fused rock phosphate.— Fused rock phosphate prepared by the Tennessee Valley Authority for release during 1942 and 1943 was tested in the greenhouse with Sudan grass and wheat. The fused phosphate contained 0.55 percent or less of fluorine. As expected, availability of the phosphorus decreased as fluorine content increased. A test with Sudan grass gave the following relative values (average of limed and unlimed soil) for recovery of phosphorus from fused rock phosphate when recovery from triple superphosphate was 100: 0.20 percent fluorine, 118; 0.36 percent fluorine, 105; 0.55

percent fluorine, 99. Fluorine had less influence on availability of phosphorus in fused phosphate in unlimed acid soil than in limed soil. Liming tended to reduce phosphorus availability of fused phosphate, as it does also with raw rock phosphate.

Size of particles of fused phosphate also had a pronounced effect on phosphorus availability, according to tests with Sudan grass. Six ranges of particle size were tested: 10-20 mesh, 40-60 mesh, 60-80 mesh, 80-100 mesh, 100-270 mesh, and smaller-than-270 mesh. Phosphorus was most available in the 80-100 mesh and 100-270 mesh ranges. In finer particles than these the phosphorus was slightly less available and in coarser ones much less available. In tests of lots of fused phosphate containing 0.3 percent fluorine and ground to pass, respectively, 6-, 40-, and 80-mesh screens, phosphorus was most readily available in the material passing the 40-mesh screen, was slightly less available in that passing the 80-mesh screen, and much less available in that passing the 6-mesh screen.

Nitrogen fertilizer on tobacco.— In 1942 the use of 32 pounds of nitrogen in sodium nitrate on plots receiving phosphate and potash increased acre-yields of tobacco 241 pounds and acre-value of the crops $93 as an average of results from the Campbellsville, Greenville, and Mayfield fields. This is an increase of almost 8 pounds, valued at $3, for each pound of nitrogen applied. Burley was grown at Campbellsville and Greenville, and dark-fired tobacco at Mayfield.

On the Station farm at Lexington in 1942, applications of 50, 100, and 150 pounds per acre of fertilizer nitrogen increased burley yields and values, respectively, as follows: 427 pounds per acre, valued at $257; 568 pounds, valued at $311; 837 pounds, valued at $430. The acre yield was 1,054 pounds, valued at $411, when no nitrogen was applied. Quality of the tobacco, as well as yield, was improved by use of the nitrogen fertilizer. Where no nitrogen fertilizer was used the tobacco brought $39 per 100 pounds; where nitrogen fertilizer was applied, it brought $45 per 100 pounds.

Potash furnished by return of manure and crop residues.— Return of manure equal to the weight of crops removed (except wheat grain) in the soil-fertility studies has furnished enough potash for good crop yields, as shown by the small response to potash fertilizer used on certain plots. As an average of comparisons at these fields and at the Western Kentucky Substation, potash applied in addition to manure, limestone, and phosphate has given the following yield increases: corn, 3 bushels; wheat, none; mixed clover hay, 280 pounds; second-year hay, none.

On plots, however, where manure and crop residues were not returned (at the Mayfield field) removal of large crops for several years has reduced available potash in the soil to the point where yields have dropped considerably and crops have responded markedly to potash fertilizers. As an average of the last three years, crop yields from this field were:

	Corn (*bu.*)	*Wheat* (*bu.*)	*1st-year hay* (*lb.*)	*2nd-year hay* (*lb.*)
Manure, limestone, and phosphate..	57.1	36.3	6869	3761
Limestone and phosphate.....	41.2	24.9	3330	2744
Limestone, phosphate, and potash...	49.8	22.8	5684	3363

Tobacco stalks for fertilizer.— Tobacco stalks, while high in plant nutrients and fertilizing value, are bulky and hard to dispose of in such a way as not to interfere with tillage and other farm operations before they rot. In comparisons of ways of handling them for fertilizer at the Station farm, some were composted and others were used as whole stalks for bedding. Composting proceeded slowly because of difficulty in packing and soaking the whole speared stalks. Furthermore, it takes large quantities of water. However, when mixed with about one-third their weight of horse manure or straw, and properly packed and soaked, they decompose satisfactorily. A little ground limestone should be added to the compost to neutralize the acids formed.

When used for bedding under horses, either with or without straw, tobacco stalks kept the horses clean and dry, and were easily tramped down and broken up to go through a manure spreader. The resulting manure was high in nutrients; unless spread and disked in soon, it lost much nitrogen. When stored outside long before spreading, most of the potassium also was lost. From stalks containing 45 pounds of nitrogen per ton, a fresh manure was produced that contained 56 pounds nitrogen per ton of dry matter (18.6 pounds per ton of fresh manure) of which 30 percent was lost by rapid drying in a current of air. The final dried manure contained 38 pounds of nitrogen per ton.

Effect of the replaceable base content of the soil on plant composition.— In studies of soils and crops from the plots of the Berea and Campbellsville soil experiment fields, the variable nutrient composition of the corn crop has been found to be influenced very largely by the availability of the soil nutrients and to a less extent by climatic and growth factors. The levels of replaceable calcium, magnesium, and potassium in the soil had a direct influence on the amount of these elements absorbed by the plant. No very important relationship

between the replaceable iron and manganese in the soil and the amount of these elements in the corn crops has been found as yet.

Pasture fertilization experiments.— Duplicate plots in two permanent pastures at the Western Kentucky Agricultural Experiment Substation have been top-dressed in alternate years since 1934 with 20-percent superphosphate, triple superphosphate, dicalcium phosphate, and tricalcium phosphate in amounts to supply 32 pounds P_2O_5 per acre. One field had received no fertilizer treatment prior to 1934; the other had been treated with limestone and superphosphate a few years earlier. On the field that had received no treatment before 1934, the plots treated with dicalcium phosphate produced 2,506 pounds of dry matter per acre in 1943 from cage clippings. No other treatment produced yields equal to the average of 2,116 pounds per acre obtained from the untreated plots. On the field which had been treated with limestone and superphosphate earlier, the untreated plots produced 1,521 pounds of dry matter per acre, while those treated with 20 percent superphosphate, triple superphosphate, dicalcium phosphate, and tricalcium phosphate produced 2,076, 1,694, 2,021, and 2,202 pounds per acre, respectively. The apparently more favorable yields from the originally untreated field were produced by the large amount of lanceleafed ragweed and buttonweed in the flora. The flora of the other field was mostly Kentucky and Canada bluegrasses and annual lespedezas.

Duplicate experiments in respect to arrangement of plots, fertilizer treatments, and seeding mixtures were laid out on two soil types in western Kentucky in 1940 to determine relative effectiveness of different methods of phosphate applications for pasture production. The average yield obtained from the plots on which 20-percent superphosphate was worked into the soil at the start was 3,005 pounds of dry matter per acre, whereas it was 2,447 pounds from the plots top-dressed with an equal amount of the fertilizer. Where ground rock phosphate was used the average yields were 2,865 and 2,467 pounds of dry matter per acre, respectively, when used without limestone, and 2,445 and 2,665 pounds when used with limestone. Where triple superphosphate, where fused rock phosphate, and where calcium metaphosphate were used the yields were essentially the same yields whichever way the materials were applied.

Hay drier.— In cooperation with engineers of the Tennessee Valley Authority, a hay drier was installed in the sheep barn on the Station farm to determine the practicability of using such driers to reduce the enormous loss of alfalfa and other hays in Kentucky each

year as a result of rainy weather during the haying season. It is estimated that, as an average, at least 60 percent of the first cutting of alfalfa is weather-damaged, and a large part of it, in some years, completely lost. The hay drier installed consists of a series of wooden air ducts on the floor of the barn loft, through which unheated air is blown by an electrically operated fan. Through these ducts the air is uniformly distributed at the floor level beneath the hay, whence it passed upward through the hay, absorbing moisture and keeping the hay from heating excessively.

Second and third cuttings of alfalfa were used over the drier this year. The second-cutting hay was cut in the morning and put into the barn by 4:30 p. m. the same day; the third cutting was mowed in the afternoon and left in the swath until 1 p. m. of the following day. This hay was put on top of the second cutting. Another small cutting of alfalfa was stored on top of the other hay on September 15. The moisture content of the hay as placed in the barn ranged from about 35 to 39 percent, whereas it is commonly recommended that for the safe storage of hay in barns not using a drier the moisture content be not more than 20 percent.

In total, 32.8 tons of hay was cured with the drier at a cost, for electricity at 3 cents per kilowatt hour, of $1.20 per ton of hay cured. The fan was operated an average of 3.65 hours per ton of hay cured. The total cost of lumber, labor, wiring, fan, and electrical equipment was $357, or about 24.7 cents per square foot of hay-storage area. The hay from both the lower and upper layers graded U. S. No. 1, extra green, averaging very high in color and in percentage of leafiness.

New tobacco varieties.— *Ky. 41A, a new root-rot-resistant burley,* was grown extensively in 1943, some 20,000 to 30,000 acres being raised, with excellent results. Several crops of seed were certified to meet the increasing demand.

Ky. 19, a new root-rot-resistant burley, was tested by a few farmers in 1943. On rich land it is a very high-yielding variety, producing about 10 percent more than Ky. 16. The color of the flyings and trash is not so good as that of Ky. 41A.

Ky. 52, a new burley resistant to mosaic and root-rot, was tested extensively over the state in 1943. It proved to be completely free from mosaic in plantings where the common varieties were heavily infected. The quality appeared to be excellent, and the yields good.

An aromatic burley variety has been developed by crossing burley tobacco with Turkish. This new variety has the aroma of Turkish

tobacco along with qualities of high-grade burley. Four commercial crops were grown in 1943.

Several mosaic-resistant burley strains (*NN*) were isolated the past year and tested in the field in black-root-rot soil. All plants were inoculated with mosaic. The new strains proved to be as resistant to black-root-rot as Ky. 16, the backcross parent, and none developed mosaic. All of the new strains were slightly earlier than Ky. 16. One strain backcrossed eight times with Ky. 16 was unsatisfactory and distinctly different from Ky. 16 in color and plant type. It evidently carried many *Nicotiana glutinosa* factors in addition to the N factor. Mosaic-resistant varieties will have a distinct advantage over susceptible varieties in addition to disease freedom, in that the stalks from a resistant crop can be used on tobacco land without danger of spreading mosaic, and thus the maximum benefit from fertilizing elements in them can be realized in increase in the tobacco crop.

Mosaic-resistant (NN) strains of dark tobacco identical in appearance with Little Orinoco, Woods, and Brown Leaf have been isolated. These new strains have remained completely free from mosaic when inoculated, and should prove of great value in certain parts of western Kentucky where mosaic causes extensive losses each year.

Frogeye leafspot of tobacco.— Frogeye, or Cercospora, leafspot of tobacco is a disease of major importance in some tobacco fields each year, causing the usual frogeye spots on the lower leaves, and green spots on the upper leaves. Spore germination tests have shown that the spores germinate only when in contact with a moist surface or in a saturated atmosphere. On several occasions inoculation of water-soaked tobacco leaves with a water suspension of crushed tobacco roots, both from the bed and field, have resulted in heavy infection of tobacco leaves with Cercospora. These results suggest that Cercospora, usually considered purely a leaf pathogen, may occur on roots also.

Angular leafspot and wildfire of tobacco.— Further studies on the life history of the bacterial leafspot organism confirmed previous findings that the bacteria live throughout the summer and winter on the roots of tobacco, legumes, wheat and other cereals, and on certain weeds. The bacteria were isolated from a field of crimson clover and a field of redtop and red clover two years after a tobacco crop. Soil samples were taken from 38 pastures and other fields where tobacco beds are commonly made, and where tobacco had not been planted for years. In more than half of these fields the angular leafspot organism was present, and the wildfire organism in a few of them. These

results prove that there is danger from these diseases in the majority of tobacco beds, and emphasize the need for treating plant beds with bluestone-lime to keep them free from bacterial leafspots.

In studies on the host range of bacteria on roots of plants, it was found that, for experimental purposes, wheat is an excellent host when sterile roots are inoculated. Roots of redtop, timothy, and especially Kentucky bluegrass are more resistant. Infection took place on the rapidly elongating zone of tissue just behind the root cap. No lesions could be found on any infected root after 5 days.

Temperature limits of satisfactory curing of burley tobacco.— During the past year some additional experiments were conducted in the curing chambers to determine the temperature limits for satisfactory curing. It was found that the minimum temperature at which burley tobacco can be cured properly, even if the relative humidity is optimum, is about 55° F, but at this temperature the time required is about twice that needed at more favorable temperatures. The maximum temperature at which burley tobacco can be cured properly is about 95° F but this requires more precise humidity control than can be obtained in a tobacco barn. Thus the practical limits of curing temperature are 60 to 90° F, as reported previously on the basis of a smaller amount of experimental work.

Effect of size of plant on optimum relative humidity for curing tobacco.— A plot of land which had been in tobacco continuously for about 35 years was divided into plots which received different fertilizer treatments. As no differences could be observed in the tobacco on three of the plots, it was combined and is designated as fertilized tobacco. The tobacco from adjacent untreated check plots was combined to form the unfertilized sample. The weight of the fertilized plants at the time of cutting was 2.24 times as great as that of an equal number of unfertilized plants.

The two lots of tobacco were cured in the curing chambers at several different relative humidity conditions. At all relative humidities the larger tobacco from the fertilized area did not lose the moisture it contained as rapidly, relative to the initial weight, as did that from the unfertilized area. As a result there was a tendency for the large tobacco to be more readily injured by high relative humidity and for the small unfertilized tobacco to be more readily injured by low relative humidity during curing. The space allowed for a definite number of large plants in curing was the same as allowed for an equal number of small plants. Obviously, the larger plants dried more slowly, largely because they interfered more with the free circulation of air than did

the smaller plants. The differences would be greater in a barn unless some means of forcing the circulation were used. Another explanation for the slower drying of the large tobacco is the greater ratio of volume to surface area in those plants. It is not possible to determine from the data obtained whether the differences in chemical composition of the two lots of plants had any effect on the rate of drying, but the difference in percentage of weight lost was greater after about a week of curing and decreased thereafter.

Carbon dioxide and sulfur dioxide in the tobacco-curing barn. — Determinations of carbon dioxide in the air in the experimental curing barn indicated that the concentration is about the same as in outside air (0.03 volume percent) in the barn with ventilators open, but because of the respiration of the tobacco, the concentration is noticeably higher (0.04-0.05 percent) when the barn is closed and higher still (0.06-0.10 percent) when coke fires are used in curing. Work was done this year on the determination of sulfur dioxide in the air in the barn. The amount found during the use of coke fires is sufficient to provide a possible explanation of some of the injury to the tobacco which may occur when large amounts of coke are used.

Rule for operating ventilators in curing tobacco.— One of the practical questions that has been foremost in tobacco curing is when to open or close the ventilators of a tobacco barn so that, by natural ventilation only, the tobacco is maintained in the best possible condition during various kinds of weather. It is true, of course, that the best condition possible may not be the ideal condition for curing. The proposed rule (thoroughly tested in a special building constructed near the experimental tobacco barn) for operating the ventilators makes use of the fact discovered by investigations at the Kentucky Experiment Station that at the optimum relative humidity for curing, the cured tobacco will be too dry to handle extensively without breakage—not "bone dry" but nearer to that than in good case. The rule is based also upon another fact discovered in previous curing experiments—namely, that the condition in the barn may be allowed to fluctuate between day and night, provided average conditions are near the optimum. Whether the ventilators should be closed or open, therefore, depends upon two considerations: (a) how long the tobacco has been in or out of case; (b) whether it is desired that the case of the tobacco be increased or decreased. As the purpose is to cause average case over a period of time to be near the optimum, how long the tobacco has been in or out of case will determine whether the case should be increased or decreased. The rule may be stated conveniently

in two parts: (A) *To lower the case of tobacco in the barn:* whenever the case of tobacco outside the barn is less than that inside, the ventilators should be opened; whereas if the case outside is greater than that inside, the ventilators should be closed. (B) *To increase the case of tobacco inside the barn:* whenever the case outside is greater than that inside, the ventilators should be opened; whereas when the case outside is less than the case inside, the ventilators should be closed.

It it obvious, therefore, that whether the ventilators should be open or closed does not depend upon the weather at a given time, but rather upon the results to be accomplished and the difference between the case of tobacco inside and outside the barn. Furthermore, the rule does not require knowledge of the relative humidity of the air.

ORCHARD AND TRUCK CROPS

The Haralson apple.— Among the many new varieties of apples being tested, Haralson was particularly promising again this year. Its chief charcteristics are early and heavy production each year, large attractive fruits of good quality, and vigorous tree growth. It ripens about September 1.

Hardy peach varieties.— For several years, peach varieties, reported to possess unusual hardiness, have been planted in the Experiment Station orchard for testing. In 1943 both winter cold and spring frosts damaged tender varieties considerably. The varieties which survived these periods and produced the largest crops of fruit were, in the order named, Mamie Ross, Veteran, Red Bird, South Haven, Halehaven, Belle of Georgia, Viceroy, July Elberta, and Niles Elberta.

Red raspberries.— A Latham red raspberry planting, used for the past 8 years for testing the effect of heavy manure mulch and different amounts of nitrogen fertilizer on plant vigor and yield, continued to show marked benefit from the mulch treatment. The stand and vigor of plants continued excellent and yields were good. Addition of nitrate of soda to the mulch resulted in reduced yields and seemed to increase the susceptibility of the canes to winter killing. Acre-yields in 1943 were as follows:

	Crates
Manure mulch	92.9
Mulch and $NaNO_3$, 285 pounds per acre	65.3
$NaNO_3$, 571 pounds per acre	30.4
$NaNO_3$, 1143 pounds per acre	21.5
Check	41.0

Fungicide treatment of seed peas.— Pea seed treated, before planting, with organic dust fungicides germinated quicker than un-

treated seed, and gave about twice as heavy a stand as the untreated seed.

Plant growth hormone (Levulinic acid) on tomatoes.— Where levulinic acid was dusted in the soil as tomato plants were set, the tomatoes ripened earlier and gave a larger total yield than where the plants were not so treated.

Effect of clipping and of oil treatment for earworm on the development of previously unpollinated sweetcorn ears.— Clipping the husk beyond the cob and oil treatment have been compared in previous reports as methods of corn-earworm control. Further comparisons were made this year to determine the effect of these methods of control on development of previously unpollinated ears. It was found that clipping did not prevent late pollination, because the silks grew out beyond the cut. Treatment with oil, however, resulted in poor pollination and failure of kernels to develop, particularly near the tip of the ear.

Soluble nitrogen in the tissue of potato vines in relation to yield.— Presence of 600 to 1,000 ppm of soluble nitrogen in the lower petioles of potato plants, just before bloom, was associated with high yields. Plants having a lower level of nitrogen were weak, and those having more than 1,000 ppm of nitrogen at this stage of growth tended to become over-vegetative and produced low yields. At other stages of growth no such relationship between amount of soluble nitrogen in the tissues and eventual yields was found.

HOME ECONOMICS STUDIES

Relation of time of applying fertilizer to content of ascorbic acid and of nitrogen in potatoes.— Irish Cobbler potatoes were planted in four 2x2x2 factorial designs, each containing four randomized blocks. Four of the plots were treated with nitrate of soda at the rate of 300 pounds per acre at the beginning of the experiment, another four plots were similarly treated just before bloom, and a third four plots were so treated after bloom. Four plots were treated with manure at the rate of 20 T per acre, and four were left untreated as checks.

About 12 pounds of potatoes were taken from each plot as a sample on which to assay ascorbic acid and nitrogen. They had been stored in the dark at temperatures that ranged for the daily average from 67° F to 86° F during the month they were stored.

Total nitrogen was determined by the Kjeldahl-Gunning-Arnold

method. Ascorbic acid was determined by the method of S. A. Morrell. Analyses were made on potatoes that weighed as nearly 150 grams as possible.

Potatoes from the check plots had less ascorbic acid than those from the fertilized plots; those fertilized with manure had less than those fertilized with nitrate of soda. Moreover, potatoes from the lot fertilized with nitrate of soda at the beginning of the expeiment had the largest amount of ascorbic acid, an average of 38.1 milligams *per cent* as compared to 35.1 and 34.1 milligrams *per cent* in those from the lots fertilized after bloom and before bloom respectively. Similarly, the nitrogen content of potatoes from the check plots was less than that in the potatoes from the other plots, and those fertilized at the beginning of the experiment had the highest content. Averages were 377, 335, 333, 320, and 310 milligrams *per cent* for potatoes fertilized at the beginning of the experiment, before bloom, after bloom, with manure, and from the check plot respectively.

Assay of ascorbic acid was also made on unpared and pared boiled potatoes and on baked potatoes. With either method of cooking the losses were small.

Effect of methods of cooking on the thiamin and niacin content of pork.— As a part of the national cooperative project on conservation of the nutritive value of foods, analyses were made on different cuts of fresh pork cooked in different ways, from 4 pigs raised under uniform conditions at the Experiment Station farm. The pigs, when killed, were 6 months old and weighed 214 to 255 pounds, averaging 240 pounds. The cuts taken for analysis were loin, spareribs, liver, ham, and shoulder. For later analysis of cured meat, the left hams and shoulders were salted, smoked, and stored in a cool, dry place.

The fresh hams and shoulders were cut into 4 pieces of uniform size after a center slice had been removed from each for frying. One of the 4 pieces was used for roasting, one for boiling, one for canning and one raw. The loins were cut into 3 pieces of uniform size to be used raw, roasted, and canned; spareribs were cut in 3 pieces of uniform size to be used raw, roasted and boiled; and livers were cut into 4 pieces of uniform size to be used raw, boiled, fried, and canned. All visible fat was removed and only the lean analyzed. Cooking methods were those approved by the Committee on Preparation Factors of the National Cooperative Meat Investigations. Thiamine was determined by the thiochrome method of Conner and Straub. The niacin method used was that of Melnick.

Greatest losses of thiamine and niacin occurred in boiling, and the least in frying. Long, slow heat seems to cause more destruction than short, high heat. In boiling some thiamine may be dissolved in the cooking water, and in roasting some may be removed in the drippings, though the differences in percentage loss of weight seem to indicate that the drippings would not account entirely for the smaller retention of thiamine in the roast. Boiling resulted in more retention of thiamine in liver than in any of the other cuts, least in ham. Roasted spareribs retained more thiamine than any of the other roasted cuts. Fried ham retained less thiamine than fried shoulder. The thiamine in liver was increased on frying or, at least, a more active response to the test was obtained from fried liver than from boiled or raw liver.

The values found in raw, lean meat for ham (883 micrograms *per cent*) are in the same range as those for spareribs (839 micrograms *per cent*) and loin, (859 micrograms *per cent*). Those for shoulder are less (741 micrograms *per cent*), and those for liver are low (285 micrograms *per cent*). However, a pound of liver will provide, after it is fried, almost as much thiamine (344 micrograms *per cent*) as a pound of ham after it is fried (485 micrograms *per cent*) although the raw lean meat of the two differ so widely in thiamine content. Also, even though the amount of waste is greater in spareribs, a pound as purchased will furnish 218 micrograms *per cent* of thiamine when roasted, as compared to the 209 micrograms *per cent* from a pound of ham as purchased and roasted and the 189 micrograms *per cent* from a pound of shoulder as purchased and roasted.

In raw, lean meat, the figures for niacin content show about the same range in ham, shoulder, and spareribs—namely 3.71, 3.28, and 3.86 milligrams *per cent*. It is somewhat lower in loin, 2.55 milligrams *per cent*, and much higher in liver, 12.28 milligrams *per cent*. The effect of cooking varies with the method and the cut of meat. In general, long, slow heat as with thiamine, results in less retention of niacin in the meat than short, high heat. It may be both because of destruction and of solvency in the cooking water. Less loss occurred in cuts containing bone and fat, like spareribs, than such meat as liver. Frying resulted in less loss in ham and liver than other methods of cooking.

INSECT CONTROL

The plant bug* Miris dolobratus *and its control.— *Miris dolobratus* was found widely distributed in Central Kentucky in 1943, but

in moderate numbers in most fields. Eggs began hatching April 28. The first adults were found May 17 and the last, June 17. Of the females, 74.3 percent were the long-winged form and 25.7 percent the short-winged form. The numbers of males and females were nearly equal.

In a field of mixed grasses, eggs were found in 14 percent of the stems of bluegrass, 7 percent of hairy chess, 3 percent of orchard grass, 2 percent of redtop, and 1 percent of timothy. The amount of pasturing of bluegrass in summer and fall affects the density of population of *Miris dolobratus* in the spring and summer of the following year. A collection of mirids from a heavily pastured field contained 124 specimens and a collection made in like manner from an adjoining lightly pastured field contained 456 specimens. On another farm, a collection from a very closely pastured field of bluegrass contained 28 specimens and a comparable collection from a lightly pastured field contained 307 specimens.

Control of grubs of the green June beetle, May beetles, and annual May beetles.— Lead arsenate was applied at the rates of ½, 1, and 2 pounds to 100 square feet of sod, for the control of white grubs feeding in and beneath bluegrass sod. The arsenate was mixed with finely sifted clay before it was applied. The plots were 10 by 20 feet and arranged for 6 replications of each treatment and 6 untreated plots. These plots are to be used several seasons to determine the effectiveness of the treatments and the time when the arsenate is no longer effective. The treatments were made in March, 1943 and the sod was examined on August 20 to September 3, 1943, to determine the amount of control. Against green June beetle grubs the ½-pound treatment for 6 replications gave an average control of 75.4 percent, the 1-pound dosage 99.2 percent, and the 2-pound dosage 99.6 percent. Against May beetle *(Phyllophaga)* grubs the ½-pound treatment for 6 replications gave an average control of 30.6 percent, the 1-pound dosage 52.6 percent and the 2-pound dosage 47.4 percent. Against annual May beetle *(Cyclocephala)* grubs, the ½-pound treatment for 6 replications gave an average control of 68 percent, the 1-pound dosage 96 percent and the 2-pound dosage 80 percent. In general, the two heavier dosages were about equally effective against the three kinds of grubs.

Species of white grubs.— A study was made of 20 species of white grubs belonging to the subfamily, Dynastinae. Included were a number of species which are serious pests of corn, sod, and vegetable crops. Species studied were *Cyclocephala abrupta* Casey, *C. borealis* Arrow,

C. immaculata Oliv., *C. pasadenae* Casey, *Dyscinetus trachypygus* (Burm.), *Ligyrodes relictus* (Say), *Euetheola rugiceps* (Lec), *Ligyrus gibbosus* (DeG.),*Oxygrylius ruginasus* (Lec.), *Pseudoaphonus pyriformis* Lec., *Aphonus castaneus* (Melsh.), *A. densicauda* Casey, *A. tridentatus* (Say), *S. antaeus* (Fab.), *S. julianus* Burm., *Strategus splendens* (Beauv.), *Xyloryctes satyrus* (Fab.), *Dynastes tityus* (L.), *Phileurus castaneus* Hald., and *Ph. illatus* Lec.

Larvae of these species were obtained by rearing, by exchange with workers in other states or were lent by the U. S. National Museum. Ways were found for separating the injurious from the noninjurious species and keys were prepared for identifying the individual species.

Methyl bromide fumigation for strawberry crown borer.— Tests with methyl bromide fumigation of dormant strawberry plants for crown borer control were continued with special emphasis on the effect of the treatment on plants of the Aroma variety. Counts made August 10 and 11 indicated that fumigation with 3 pounds of methyl bromide per 1,000 cubic feet for a 4-hour period at chamber temperatures between 70° and 76° F and load temperatures of 65° to 73° F had little or no effect on subsequent runner formation and number of runner plants produced.

Fruiting records were secured by the Horticulture Department for rows of Blakemore strawberries started in 1942 with heavily fumigated and with unfumigated plants dug in spring and in fall. There was no significant difference in the yields of the 5 rows (80 feet long), which ranged from 99.26 to 130.46 crates per acre.

Codling-moth control.— Carryover of codling-moth larvae from 1942 was small, but 1943 conditions were favorable for codling-moth development. Moth emergence began May 16 at Lexington and continued into the second week in June. Emergence of first-generation moths began July 14. An intensive lead-arsenate and weak-bordeaux spray program applied to both station orchards resulted in an unusually clean crop of apples. In the young orchard, at harvest, Red Delicious had 92.6 percent clean fruit, 5.7 percent stung, and 1.7 percent wormy. Staymans had 93.8 percent clean fruit, 3 percent stung, and 3.2 percent wormy. Winesaps had 97.93 percent clean fruit, 1.65 percent stung, and 0.42 percent wormy. In the old orchard, at harvest, Red Delicious had 54 percent clean fruit, 18 percent stung, and 28 percent wormy.

Tomato-fruitworm control.— Lead-arsenate-cornmeal bait, cryolite-cornmeal bait, cryolite-Pyrax ABB dust, lead-arsenate spray, and calcium arsenate dust were compared as control measures for tomato

fruitworm in two replicated series of plots. On plots of Earliana tomatoes treated with these materials 2.0, 4.4, 5.1, 5.3, and 11.1 percent, respectively, of the fruits harvested from June 23 to July 20, were wormy compared to 38 percent in the six check plots. On plots of Baltimore tomatoes 2,56, 3.5, 2.7, 3.5, and 5.2 percent, respectively, of the fruits harvested were wormy compared to 19.7 percent in six check plots. The natural infestation in the Baltimore tomato plots was augmented by placing 4 newly hatched fruitworms on each plant, late in July. All the materials reduced fruitworm damage effectively, though the calcium arsenate gave the poorest results.

Plum curculio.— Studies on the life history of the plum curculio were made in cooperation with a number of western Kentucky peach growers, so that spraying could be timed to secure maximum results. Drop trays and emergence cages were maintained at Sedalia, Paducah, Henderson, Princeton, and Lexington. There was a heavy emergence of new-generation adults and considerable second-brood damage to peaches in western Kentucky. In one orchard where the complete schedule was used, 3.3 percent of the Elbertas were injured at harvest, while 11 percent were curculio-damaged where the month-before-harvest spray was omitted.

Oriental fruit moth parasites.— To check on the establishment of *Macrocentrus ancylivorus,* an important oriental moth parasite, 14 collections totaling 1,477 peach twigs infested with oriental moth larvae, were made during June in 14 western Kentucky peach orchards. From these were reared 410 oriental moths and 121 parasites. *Marcrocentrus ancylivorus* was recovered only from twigs collected in two Henderson orchards. The native parasite, *Eubadizon pleurale* was recovered from collections made in 9 of the 14 orchards, and was important this season in reducing the oriental-moth infestation.

Early in July, 8 colonies of *Macrocentrus ancylivorus,* totaling 2,000 individuals, were released in 8 peach orchards in Paducah and vicinity. These were made available by the federal Oriental Moth Parasite Laboratory of Moorestown, New Jersey.

Control of chicken lice.— Nicotine sulfate roost paint and nicotine sulfate applied directly to the birds by the drop method, were compared in the Station poultry pens during cold weather, the night temperature ranging from 49° to 25° F. Each treatment was used January 25, in 4 pens of birds and a second treatment 2 weeks later. Both treatments were practically 100 percent effective in the control of shaft and body lice. These results were surprisingly better than those from similar treatments made previously at higher temperatures.

CHEMICAL RESEARCH

Analyses of limestones, marls, and soils.— During the year 137 samples of limestone, from 54 counties, were analyzed for percentage of calcium and magnesium carbonates and a sieving test was made on each sample of ground stone to ascertain the suitability of the fineness of grinding to meet agricultural needs. During the year, also, 183 samples of marl sent by county agents and farmers, from 27 counties, were analyzed for neutralizing value, and 187 samples of soil sent from 39 counties were analyzed for soil acidity (pH), total nitrogen, total phosphorus, and available potassium.

Tobacco-seed oil.— Expression of oil from tobacco seed progressed to the point where more than half of the oil content was pressed out in 3 hours. This oil is light yellow and requires relatively few bleaching operations. Subsequent extraction of the press cakes with n-hexane increases recovery to a total yield equivalent to that obtained by total extraction. This extracted oil is deep yellow and requires much more bleaching. Time and solvent requirements are materially reduced by this combined procedure.

Nicotine dust as insecticide.— An insecticide dust containing 10 percent nicotine was made from tobacco extracted with solvent, dried, and finely ground. This was diluted to 2-percent nicotine content by adding 1 part of hydrated lime and 3 parts of Pyrax ABB (pyrophyllite) to 1 part of the 10-percent dust. In laboratory tests with 3 species of plant lice, *Aphis rumicis* L., *Aphis nerii* Fons., and *Macrosiphum gei* (Koch), at temperatures of 78° F or above, the 2-percent dust gave 93.2 to 100 percent kill in 24 hours. For best results, lime also was necessary with this dust. A 1-percent dust of a similar formula gave poor control. In comparative tests, 0.5 percent rotenone dust acted very slowly and gave much poorer results than the 2-percent nicotine dust having lime in the formula.

Nicotinic acid by the oxidation of nicotine.— Production of nicotinic acid (niacin) from nicotine was investigated by several oxidation procedures. By oxidation with nitric acid and subsequent purification, better yields of the acid were obtained than those reported by other investigators. Oxidation with potassium permanganate was accomplished. Methods of separation of the product from the inorganic salts are now under investigation. If a method of separation is found giving fairly good yields without great difficulty, such a method would be less costly than those now used.

Growing tobacco for nicotine production.— Brasilia and Olson strains of *Nicotiana rustica* were grown in the field and analyzed for nicotine content. From the results obtained these varieties are too sensitive to growing conditions to offer much promise for consistent high-nicotine production in Kentucky. This bears out results obtained by investigators in other localities, both where tobacco is generally grown and where it is not generally grown.

Eighty-seven samples of dark tobacco grown and cured at the Princeton Substation were analyzed for nicotine content. From these data nicotine yield was correlated with (1) variety or strain of dark tobacco, (2) fertilizer treatments, (3) crop rotations and (4) location of nicotine in the plant regions. In general, more promise of obtaining a high-nicotine strain of tobacco for commercial production in Kentucky seems to be offered by plant breeding in dark tobaccos than by development of a strain of *Nicotiana rustica.*

Uses for low-grade tobacco.— In continuation of the investigations of new uses for low-grade tobacco, the following progress was made this year.

Fat, resin, and *wax.* After separation of the wax (7.07 percent of the extract) the acetone-soluble portion was further separated into fractions with the following results: phenolic, 2.48g, 1.6 percent; basic, 30.50g, 19.4 percent; neutral unsaponifiable, 85.00g, 54.0 percent; and acids from saponification, 28.90g, 18.4 percent. The alcohol portion from saponification is solid, brown, and reacts chemically like phenols, being insoluble in water and dilute acids but soluble in dilute alkali. Exclusive of this, the fractions separated represent 93.32 percent of the acetone-soluble extract.

Plastics. Plastic discs of the protein-aldehyde type with properties equal to the phenol-aldehyde type reported previously were molded under heat and pressure. At present phenol is a critical material giving added significance to the phenol-free type. The materials used for this plastic were furfural or formaldehyde, extracted tobacco-seed meal, and tobacco-fiber filler. No precooking operation is required—another advantage of this type of plastic.

Fiberboard. Five-inch squares of fiberboard were made using various percentages of sodium silicate and lignocellulose with the processed tobacco fiber. The boards were pressed with the Carver press using the electric hot plates. In this way lateral shrinkage was reduced to a minimum and water absorption decreased materially.

Paper. Several 5-inch circles of ivory-colored paper were made from the pulp of processed tobacco fiber after bleaching. The paper was

made in different thicknesses and with varying amounts of starch as sizing. The tobacco fiber was bleached only with great difficulty. In these laboratory samples, increased thickness made the product more brittle and less resistant to tearing. Addition of starch sizing had the same effect, although 1 percent starch sizing gave best results with regard to uniformity of appearance.

Equine incoordination (wobbles).— Blood samples from 4 young wobblers, the mother of a wobbler foal, and 3 normal young horses were analyzed for certain important mineral elements. No differences in concentrations of these inorganic constituents could be associated with the condition. Neither a wobbler nor a normal filly showed any marked changes in the concentrations of calcium, magnesium, phosphorus, iron, copper, manganese, boron, or fluorine of the blood when consuming for 3 weeks air-slaked lime equivalent to 3 percent of the grain mixture consumed.

Effect of manganese intake on urea excretion in rats.— At the end of three months on a milk-iron-copper-manganese ration the urea output of 6 young rats over a three-day period did not differ appreciably from that of their pair-fed mates which received no manganese supplement. Manganese-fed animals excreted 82, 87, 88, 107, 113, and 118 percent of the urea excreted by their respective control mates. A similar study was made on 6 pairs of rats confined to a diet consisting of relatively pure ingredients low in magnesium as well as in manganese. During a 3-day period five of the manganese-fed animals showed increased urea output, the urea values being 92, 105, 108, 116, 122, and 151 percent of those of the respective controls. However, when food consumption was limited to about one-half of the normal intake, the manganese-fed animals, in the order listed above, excreted 89, 106, 92, 96, 91, and 85 percent as much urea as their respective control mates.

Ascorbic-acid synthesis in relation to manganese intake.— Young guinea pigs weighing 200 to 250gm were placed on a scorbutic diet with and without manganese addition in order to check the claim that high concentrations of manganese favor synthesis in vitro of ascorbic acid by guinea pig liver. Survival period was used as an index of ascorbic-acid synthesis. A total of 12 pairs were used. There were 3 pairs in which the control and manganese-fed animals died on the same day. Four controls outlived their manganese-fed mates by 1, 1, 1, and 3 days, respectively. Five of the manganese-fed animals outlived their mates by 1, 1, 3, 7, and 10 days, respectively. The longer

survival period of the last two animals receiving manganese is probably insignificant in view of the other results.

Effect of manganese intake on bisulfide binding substances in blood.— Twenty-eight young white rats were pair-fed a milk-iron-copper ration with and without manganese addition (0.1 mg per 100 cc of milk) for three months. Following a 12-hour fasting period the animals were killed by decapitation and the bloods analyzed for bisulfite binding substances. The values obtained for the manganese-fed rats were 65, 74, 84, 84, 86, 94, 100, 101, 108, 111, 112, 115, 118, and 134 percent of the values for their respective pair mates. Evidently, no increased activity of cocarboxylase was induced by increasing the manganese intake of these rats.

A similar study was made upon rats consuming a milk-iron-copper ration enriched with carbohydrate by addition of 5 gm of glucose per 100 cc of milk. Both control group and the manganese-fed group were fed *ad libitum*. Three different treatments were accorded the animals prior to obtaining blood samples. (1) When fasted 12 hours before being killed, two manganese-fed animals contained in their blood 97 and 116 percent, respectively, as much BBS as was found in the control mates. (2) When fed their respective rations equivalent to 5 percent of their weight and killed at the end of a 2-hour interval the two manganese-fed animals contained 90 and 105 percent of the BBS concentration found in the bloods of the two respective controls. (3) Two additional pairs were fasted 18 hours, then fed by stomach tube 5 cc of glucose containing an amount of sugar equivalent to 0.5 percent of the body weight and killed after a 2-hour interval. Here again there was no evidence of cocarboxylase activation for the concentrations of BBS in the manganese bloods were 89 and 113 percent, respectively, of the amounts found in bloods of the control animals.

The effect of copper, boron, manganese, and zinc on enzyme activity.— The results of previous enzyme studies on isolated leaves of copper-treated plants were confirmed by studies with entire plants. Invertase and catalase reached maximum activity with 0.01 ppm copper, while activity of peroxidase decreased with all additions of copper. Activity of oxidase increased regularly with increasing copper up to 0.10 ppm.

Catalase and invertase activity in alfalfa plants grown in drip sand cultues, increased with increasing concentrations of boron up to 1 ppm. Peroxidase attained maximum activity with 0.25 ppm boron, while oxidase was not affected by different amounts of this

element. Catalase, peroxidase, and oxidase increased in activity with zinc additions up to 1 ppm. Invertase was adversely affected by all concentrations of zinc used. Manganese concentrations of 1 and 2 ppm reduced the activity of catalase, oxidase, and invertase in alfalfa. Peroxidase responded favorably to 1 ppm manganese.

Enzyme activity varied with the stage of development of tomato fruits and leaves. Catalase and peroxidase declined in activity steadily as the fruit ripened while activity of invertase increased with ripening. In the leaves activity of oxidase declined regularly with increasing age. The other three enzymes showed increased activity until maturity, and then declined as the leaves aged.

Copper in the growth of tomato plants.— Further studies of the effect of copper on the tomato plant were made. Where less than 0.05 ppm copper was available to the roots in solution cultures growth was reduced; in solutions ranging from 0.05 to 1 ppm copper the plants grew satisfactorily and at about the same rate. Extreme toxicity was evident with 2 ppm copper. Early deficiency symptoms resembled drouth responses. Conditions favoring low transpiration in one experiment, however, did not prevent the occurrence of these symptoms.

The copper content of plants grown in solutions having less than 0.05 ppm copper was not substantially different from that of plants receiving up to 0.10 ppm copper. Plants grown in solutions at higher concentrations of copper than 0.10 ppm contained somewhat greater amounts of this element. Necrotic lower portions of plants grown in low-copper solutions contained a larger percentage of copper than upper parts of the same plants which had not yet shown the effect of insufficient copper. This suggests that the copper is fixed in an immobile form.

Reproduction of rats on low-boron rations.— Studies of reproduction of white rats on low-boron rations were extended during the year to 3d-generation mothers. Thirty-four females of the three generations on low-boron rations gave birth to a total of 80 litters consisting of 530 young. Controls (30 females) which received the same rations with small additions of boron produced 74 litters consisting of 472 young. No evidence, such as comparative size of litter, mortality of young, or rate of growth, has indicated a beneficial effect of the added boron.

In general a low-boron ration containing 8 percent of butterfat has proved more satisfactory than one in which 1 percent of corn oil was used as the carrier of fat-soluble vitamins.

Effects of boron deficiency on soluble nitrogen and carbohydrate content of alfalfa.— Boron-deficient alfalfa plants grown in the greenhouse in sand culture were analyzed for total ammonia, amide and nitrate nitrogen present in a soluble form, reducing sugars, and sugars hydrolized by invertase. Results obtained were compared with those obtained from similar analyses of normal plants grown under the same conditions. All soluble forms of nitrogen (except nitrate), reducing sugars, and sugars hydrolized by invertase were found to be present in excessive amounts in the boron-deficient plants. Apparently, the metabolism of nitrogen does not proceed in a normal fashion if boron is not available to the plants in sufficient amount to prevent the characteristic visual deficiency symptoms.

Effect of minor elements on yield of alfalfa.— In an experiment conducted in the greenhouse with alfalfa growing in soil from the Station farm at Lexington, little improvement in yield of dry hay was recorded when the minor elements (boron, copper, zinc, and manganese) were applied to the soil singly and in various combinations. Apparently, this soil contains sufficient amounts of these elements to supply the needs of alfalfa when grown under the ideal conditions existing in the greenhouse.

ANALYSIS, INSPECTION, AND CONTROL SERVICES

Fertilizer control.— During the year, 601 inspection samples and 49 farmers' and departmental samples were analyzed. An additional 552 determinations were made in investigational work. This laboratory collaborated with about 70 state and commercial laboratories in the analysis of a monthly check fertilizer sample.

Investigational work was continued on the method for acid- and base-forming quality of fertilizers. Collaborative work on the method was continued with 9 chemists participating. A report of this work was made to the Association of Official Agricultural Chemists, and some changes in the method have resulted.

Feed control.— During the year, 1,017 inspectors' and dealers' samples of feed were analyzed, and an additional 272 determinations were made on miscellaneous and investigational samples. This is exclusive of research work which cannot be so estimated. With few exceptions, the results of this year's inspections were remarkably good considering the difficulties under which the manufacturers operated. The chief cause for deficiencies in protein and fat was the use of unusually large amounts of ground wheat in feeds.

A published report was made on the A.O.A.C. investigation of

fat in cooked animal feeds containing cereals. It will be necessary to investigate this problem more fully before further collaborative work will be of much value. Again this year, the Feed Laboratory collaborated with the Association of American Feed Control Officials in investigational work.

Considerable attention was given to distillers' grains. The emergency has forced the distillers to use large proportions of grains other than corn, thereby altering the composition and analysis of the dried grains and solubles—riboflavin, particularly, is thus greatly reduced.

Seed inspection.— During the twelve months ending December 1, 1943, the seed analysts tested 6,146 samples of seed. Of this number 523 were official (or collectors') samples, 874 were tobacco samples, and the remainder, or 4,749, were miscellaneous samples. Purity separations were made on 3,553 samples and germination tests on 5,898. The samples received are classified as follows: grasses, 1,189; clovers, 2,074; cereals, 1,041; large-seeded legumes, 246; hemp, 71; vegetables, 77; miscellaneous, 51; official, 523; and tobacco, 874. Tobacco seed cleaned during the year amounted to 2,764 pounds, in 692 lots. These figures compare favorably with those for last year when 911 lots containing 2,683 pounds were cleaned.

As a part of the federal hemp program, the Kentucky Agricultural Experiment Station tested for the Commodity Credit Association 7,353 samples of hemp seed for purity and germination. In a similar way and under the same conditions work has now been started upon the testing of the 1943 hemp crop, involving about 10,500 samples representing the same number of lots of seed.

Nursery inspection.— The demand for fruit trees for home orchard planting was unusually strong this year. All available stocks of fruit trees in Kentucky nurseries were sold. Understocks for the grafting and budding of apples, pears, and cherries were scarce and this condition will be reflected in a smaller supply of these items available during the next two years.

Nurserymen have done an excellent job of keeping their stock sprayed, pruned, and cultivated in spite of the shortage of labor and supplies. The most acute labor shortage was of skilled workmen for handling landscape material.

Because of the shortage of labor and the unfavorable weather conditions which prevailed during February and March, a smaller acreage than usual was planted to strawberries in the state this year. Hot, dry weather during midsummer and early fall retarded the development of new plantings to such an extent that many growers con-

sidered it inadvisable to offer their plants for sale. Consequently, there were no requests for strawberry inspection this year.

The nursery inspector made 79 regular inspections including 1,016 acres of nursery and 16,100 square feet of sweetpotato plant beds.

In the order of their frequency of occurrence the following insects and plant diseases were found during the course of regular inspections: *(insects)* bagworm, red spider, oriental fruit moth, white pine bark aphids, dogwood borer, elm leaf beetle; *(diseases)* cedar rust, iris leaf spot, weeping willow canker, iris rot, cherry leafspot, delphinium crown rot, peony blotch, birch leafspot, fireblight, phloem necrosis (elm).

As only 1 Japanese beetle was taken in traps in the Louisville area in 1941 and 1 in 1942 no traps were placed in that area this year. No Japanese beetles have been taken in the Lexington area since 1938.

Kentucky has been officially removed from the list of states infected with phony peach disease. The last tree found infected with this virus was in Webster county in 1939.

Phloem necrosis, a virus disease of elms, for which there is no known satisfactory remedy, continues to take a heavy toll of elms in the area of Kentucky north and east from Louisville and Lexington.

Public Service Laboratories.— During the year 32,251 specimens were examined in the several laboratories of this department. Of the total specimens, 30,017 were examined in the bacteriological laboratory, of which 4,233 were throat swabs cultured for diphtheria and 4,233 were specimens for hemolytic streptococci; 1,423 specimens of sputa were concentrated, stained and examined for tubercle bacilli by microscopical examination and 348 were found to be positive. Cultures were made for typhoid, paratyphoid, and dysentery on 2,214 stool and 2,184 urine specimens, chiefly from food handlers; 6,570 specimens were examined for gonorrhea; 1,857 specimens of feces for hookworm and other intestinal parasites. A total of 511 animal heads were examined for rabies, an increase of about 50 percent over last year; 325 or 63.6 percent were positive. Bacteriological examinations were made on 3,988 samples of water and 2,124 samples of milk, cream and ice cream for sanitary quality. Sixteen samples of market cheese were examined for filth and coliform organisms. Agglutination tests were run on 290 samples of blood for typhoid, paratyphoid, undulant fever, and tularemia. Fifty-seven samples of food were examined for spoilage or food poisoning organisms in connection with a number of cases of mass food poisoning. A total of 24,420 specimen containers were sterilized, assembled and sent out to County Health Departments.

The food laboratory examined 2,023 specimens of milk, butter, cheese, ice cream, chocolate milk, hamburger and other meat products for adulteration with cereal and preservatives, cornmeal for rodent and insect contamination, coffee and coffee substitutes for misbranding; canned tomatoes for molds, yeast and other evidence of spoilage. Of 1,796 milk samples, 88 were found to contain added water, ranging from 5 to 40 percent; and from 21 out of 33 counties submitting milk for examination, 37 milks and 15 chocolate milks were found to be below legal standard for butterfat.

The drug laboratory made analyses of 211 specimens, of which 40 were official drug samples consisting of 6 samples of barbiturate tablets, 3 hair dyes for harmful dyes, 2 samples of whisky, 2 samples of mouse seed, 3 antimalarial preparations, 15 samples of coffee and coffee substitutes for microscopical examination for adulterants, and several miscellaneous products. Examinations were made of a wide variety of miscellaneous products for poison from accidental or intentional administration, of which 16 were in connection with cases of poisoning, either of humans or animals.

Eighty-seven samples of water were examined, chiefly in connection with sewage and industrial waste pollution of streams for the Division of Game and Fish, the Bureau of Sanitary Engineering, and several County Health Departments.

Creamery license section.— Licenses to buy milk or cream on butterfat basis issued and in force totaled 1,073, of which 1,043 were renewals and 30 were issued to establishments beginning operation after July 1. The total included 8 creameries, 16 cheese plants, 7 condenseries, 74 milk plants and ice cream manufacturers, 32 independent operators of cream stations, and 936 cream stations under contract to creameries. Authority to test for the period ending June 30, 1944 was issued to 1,157 operators using the Babcock test. These included 918 renewal licenses, 135 licenses issued since July 1 after satisfactory examination, and 104 permits pending examination issued since July 1.

Examinations for applicants for license to test were held as follows: Bowling Green, 4; Lexington, 4; Louisville, 5; Mayfield, 4; Maysville, 2; Owensboro, 3; Princeton, 4; Somerset, 3; Walton, 2; Ashland, 2; Columbia, 2; special, 2. Of 535 applicants notified to appear for examination, 296 appeared, 256 passed, and 40 failed. Of those failed, 3 reappeared and 2 passed on the second examination.

During the year 737 inspections, including 18,284 tests, were made.

Creamery operators were graded as follows: A and B (satisfactory) 362 operators; C (unsatisfactory) 200; D (probation) 160; and E (cited to appear before the Examining Board) 15. Satisfactory inspection certificates were issued to operators grading A or B.

Of 23,063 milk and cream test bottles, cream test weights, and milk pipettes received for calibration, 165 were rejected. Items of buying equipment in use, found on inspection to be incorrect or defective and therefore the cause of inaccurate weights or tests, were: 6 test scales, 54 cream test weights, 16 platform scales, 22 platform scale weights, 9 centrifuges, 4 dividers, 5 thermometers, 177 pieces illegal glassware, and 15 miscellaneous pieces of equipment. These were condemned and ordered to be replaced.

The Examining Board decided 10 cases as follows: 3 revoked licenses were reinstated, 4 testers were continued on probation subject to future inspections, and 3 licenses were revoked because of unsatisfactory testing and violation of rules and regulations. There were 2 testers on probation by the Examining Board at the beginning of the year and 4 at the close.

Receipts for the year were $8,205.86; and expenditures $9,292.94, as itemized:

Salaries and labor	$6,259.89
Communication service	166.70
Freight and express	134.27
Sundry and laboratory supplies	96.13
Travel	2,304.22
Miscellaneous	57.93
Furniture and fixtures	273.80

SUBSTATIONS

WESTERN KENTUCKY SUBSTATION

Dairy herd.— Total dairy stock on the farm averaged about 35 head for the year. Complete records on production, feed consumption, and breeding were kept, and the Substation continued as a member of the local Dairy Herd Improvement Association. The average number of cows in the milking herd for the year was 15.6, and the average production for the year was 6,975 pounds of milk and 361 pounds of butterfat. Average production was somewhat lower than last year, largely because there were quite a number of heifers and young cows in the herd this year sired by Gold Dollar Bill and their production did not come up to that of the older cows. Gold Dollar Bill was replaced about two years ago by Design Raleigh whose daugh-

ters will come into production next year, and whose half sisters in the Station herd at Lexington have produced well. Design Raleigh was replaced this year by a young bull, Remus Gauntlet, from the Station herd at Lexington.

Poultry.— Two breeds of chickens, Barred Plymouth Rocks and New Hampshires, are now being carried at the Substation. Six hundred baby chicks of each breed were brooded this year and about 200 pullets of each breed were placed in the laying houses this fall. Also, one pen of old hens of each breed is carried. The young chickens were used in a feeding experiment, comparing meat scrap versus soybean oil meal and bonemeal as protein supplements in the growing mash (see page 23).

The entire poultry flock was recently blood tested for pullorum disease and no reactors were found. At the same time, the flocks were rigidly culled and high production is expected during the winter and spring months.

Hybrid corn yields.— Twenty-two corn hybrids were grown this year, each replicated 6 times, a total of 132 separate 1/120-acre plots. Acre-yields (averages of the 6 replications) were as follows:

	Bushels		*Bushels*
Ky. 122	59.5	Ky. 204	51.8
Ky. 228	57.3	Ky. 212	51.5
Pioneer 300	57.0	Ky. 207	50.8
Ky. 205	56.3	Ky. 227	50.4
Ky. 215	54.7	Ky. 72B	50.1
Ky. 120	54.1	U.S. 13	49.7
Ky. 203	53.3	Ky. 225	49.2
Ky. 226	53.3	Pfister 164	48.8
Ky. 102	52.5	Ky. 106	47.9
Ky. 123	52.4	Tenn. 14	47.1
Ky. 103	52.4	Ky. 209	46.9

Yields were reduced somewhat by lack of rainfall during three weeks in July when corn was at a critical stage, and by a 4-week drouth in August.

Wheat variety test.— Seven varieties of wheat were grown each year for the past three years, each variety replicated several times. Yields of Thorne variety exceeded all others by about 2 to 5 bushels per acre. Average yields, in bushels per acre, for the three years were: Thorne, 32.0; Ky. NS6, 29.9; R47, 28.7; Kawvale, 28.7; Fulcaster, 27.9; Trumbull, 27.7; Nabob, 27.2.

PRINCETON SUBSTATION

Pasture experiments.— Grazing began April 21 on both treated fields and continued 175 days; on the untreated field it began May 5 and continued 161 days. Field 3, which has received about 1,660 pounds of superphosphate per acre in 6 applications during the 15 years of the experiment, produced 186.6 pounds per acre gain in weight of steers during the season. On Field 2, which has received about 2,900 pounds of ground rock phosphate per acre in 5 applications (equal in money value to the superphosphate applied to Field 3), the gain in weight of steers was 153.9 pounds per acre. On the untreated field the gain of steers was only 36.7 pounds per acre, and at the end of the season they were definitely poorer in finish than those on the treated fields.

Herbage on the untreated field was mostly lance-leaved ragweed *(Ambrosia bidentata),* buttonweed *(Diodia teres),* Canada bluegrass, and common lespedeza. On Field 2, Kentucky bluegrass, common lespedeza, and hop clover *(Trifolium dubium)* were dominant, though sourdock, field daisy, and broomsedge were prominent. The vegetation of Field 3 was mostly Kentucky bluegrass, but Canada bluegrass, common lespedeza, and Korean lespedeza contributed much herbage.

Legume nitrogen vs. fertilizer nitrogen for crops.— In a study at the Princeton Substation, corn, wheat and timothy are grown in rotation on three sets of plots all of which are treated alike with limestone, superphosphate, and potash. On one set, nitrogen fertilizer is used at the rate of 100 pounds of sulfate of ammonia per acre on each of the three crops in the rotation; on the second set, clover is grown in mixture with the timothy as a source of nitrogen; and on the third set, neither nitrogen fertilizer nor legumes are used. As an average of the 16-year period 1928-1943, acre-yields of the three sets of plots were as follows:

	Corn (*bu.*)	*Wheat* (*bu.*)	*Hay* (*lb.*)	
No nitrogen	42.8	14.4	1833	(timothy)
Legume nitrogen ...	49.7	17.2	2783	(clover and timothy)
Fertilizer nitrogen ..	48.6	18.7	2603	(timothy)

Apple variety and cover-crop tests.— The heaviest apple crop yet produced by this orchard was harvested in 1943. The average yield of all varieties and plots was 6.1 bushels per tree. The average yields per tree were Stayman, 8.6 bushels; Yellow Transparent, 7.9 bushels; Red Delicious, 5.1 bushels; and Winesap, 2.6 bushels. As an average for all varieties, Plot 1 (summer cover crop of soybeans followed by a winter crop of rye and vetch) produced slightly more than

Plot 2 (permanent korean lespedeza sod with a tree mulch) or than Plot 3 (permanent korean lespedeza sod without the mulch). This was the heavy-bearing year for Yellow Transparent in Plot 1 while many of those in Plot 2 and 3 bore lightly.

Increase in trunk circumference averaged 1.55 inches for Plot 1; 1.77 inches for Plot 2; and 1.86 inches for Plot 3. In color and size of foliage and general tree vigor Plots 2 and 3 were noticeably ahead of Plot 1. Also, in fruit size and color in all varieties Plot 1 was behind Plots 2 and 3. These results were in line with the general trend noticeable in the past few years, that Plot 1, cultivated in spring and summer, is gradually losing vigor as a result of soil loss from erosion, while the vigor of the plots in lespedeza sod (Plots 2 and 3) is very satisfactory.

Peaches.— Because of unfavorable winter temperatures and untimely spring frosts there was no set of fruit in the peach orchard on limestone soil, again proving the value of elevation in an orchard site. The orchard on the higher sandstone soil produced a very small fraction of a crop—too small to show any plot trends. In the young peach-variety orchard the following varieties proved to be the most hardy this season: Viceroy, Veteran, South Haven, Vedette, Georgia Belle, and Early Rose.

Strawberries.— Fourteen varieties and selections of strawberries were fruited here this year, the second harvest year for this planting. Averaging all varieties, the 1942 yields were 202 crates per acre for the first harvest year and the 1943 yields were 152 crates per acre. Seasonal conditions, however, favored the 1942 yields. The highest yielding varieties were Blakemore, N.Y.7821, and six of the Tennessee selections. All three of the new varieties, Tennessee Shipper (148), Tennessee Beauty (263), and Tennessee Supreme (260), held up in yield the second year even better than Blakemore. Tennessee Beauty and Tennessee Supreme made the highest second-year yields, 257 crates per acre each.

A comparison was made of early winter versus spring mulching of strawberries prior to the second harvest year. The average yield of all plots showed a slight advantage for spring mulching, which was contrary to the results usually obtained from mulching preceding the first harvest year. The winter, however, was not severe.

Two strains of yellows-free Blakemore plants, McUmber's strain and a U.S.D.A. strain, were obtained in 1939. To date no yellows has appeared in progeny from these original plantings. The McUmber strain has proved to be the more vigorous and the heavier yielding.

Twenty-four strawberry varieties and selections were set in a new planting in the spring of 1943. This planting included 7 of the most promising varieties of past tests, planted in rows 25 feet long and replicated four times each; one plot each of 7 other varieties that are being continued for further study; and one plot each of 10 new selections from the U. S. Department of Agriculture.

Farm wood-lot demonstration.— A farm wood-lot management demonstration was begun in the farm woodland on the Substation farm this year. About 10 acres of this woodland was fenced off for protection against livestock. Three acres of this area were staked off for use in a special wood-lot management demonstration. The mature trees were cut from the 3-acre plot and a few were also cut from the remainder of the 10 acres. These trees were worked up into saw logs and firewood. From the 3-acre plot the underbrush and undesirable species of trees (cedar, dogwood, redbud, and so on) were cleared. An underplanting of white oak seedlings was made at the rate of 500 trees per acre. These seedlings, planted in late March, started off well during the wet spring and most of them survived the summer drouth.

From the mature trees harvested, 39 saw logs were obtained. These were sawed into 5,859 board feet of lumber of suitable dimensions for use about the farm. In addition to this lumber, 34 cords of firewood were obtained from these trees.

In the open, outside and adjacent to the woodland, a planting of 200 loblolly pine, 200 short-leaf pine, and 1,500 black locust seedlings was made. The locust seedlings were set in contour furrows. The pines were set at random in and around an eroded area. Rainfall was heavy during May and June but was light during the summer and fall. Most of the locusts and about 60 percent of the pines survived.

ROBINSON SUBSTATION

General farming.— Crops as a whole this year were as good as they have been for the past two or three years, if not better. In spite of continued rainfall in the early spring good crops of corn and hay were produced. The corn, on 20 acres, produced an average of 63 bushels to the acre, though on 8 of the 20 acres it failed to harden before frost and was fed out to cattle early in the fall to good advantage. Aside from plot corn, all seed used was hybrid. U.S. 13 and 102 hybrids again proved best adapted to this section. Some 80 tons of hay was produced from 2 acres of alfalfa, 7 acres of lespedeza, and 4 acres of soybeans; and in addition hay was saved from all of the

agronomy plots. To supplement the hay there was a goodly amount of corn stover, which was fed to the cattle in the pastures.

Fruits.— The apple crop amounted to about 400 bushels, and sold readily at the orchard at $1 to $3 a bushel. There was quite a demand this year as no one, other than the Substation, had a crop of apples in the county.

There was no peach crop at the Substation this year; the buds were killed by a heavy freeze in March.

Livestock and poultry.— Experimental work was carried on with dairy cattle, hogs, and poultry. The principal work with dairy cattle is a project which has to do with breeding up scrub cattle by the use of a purebred Brown Swiss bull. Animals used in this project were one purebred Brown Swiss bull, three purebred Brown Swiss cows, three grade Jersey cows, and four scrub (common) cows. To the present the increase has consisted of four bull calves from the three Brown Swiss cows, and one half-Swiss heifer calf, with many of the Swiss qualities, from one of the scrub cows.

Duroc Jersey and Hampshire are the two breeds of hogs used at the Substation, and these two breeds are recommended for use in this part of the state.

Barred Plymouth Rock and Rhode Island Red chickens and Bronze turkeys are raised, all three being recommended for use in this section.

The past spring 1,100 baby chicks and 400 poults were hatched at the Lexington Station and brooded at the Substation. Of the chicks raised, 120 Barred Plymouth Rocks and 120 Rhode Island Reds were placed in the laying houses the first of October as pullets and will be carried and trapped as layers for one year.

Sorghum sirup.— Untreated plots in the fertilizer test produced eighty-one 10-pound pails of 80-percent sirup per acre. Plots fertilized with phosphate and potash fertilizers lacking nitrogen produced somewhat less sirup than the untreated plots. A complete fertilizer supplying 32 pounds of nitrogen to the acre, at the row, increased the yield to 130 pails per acre, and a plot limed in 1940, receiving complete fertilizer, produced 183 pails per acre. Apparently the better legume and grass growth on this plot than on the unlimed plots, during the alternate years, is improving the soil for sorghum production.

The variety test included twenty-one varieties, each popular in the locality from which it was obtained. They varied in yield from 72 to

180 pails of sirup per acre. The Williams variety produced 157 pails of sirup that was better in quality than that from other high-yielding varieties.

NEW PROJECTS — 1943

Utilization of tobacco stalks and other crop residues on Kentucky farms for fertilizer purposes.

Tests of response of general field crops to chemical nitrogen.

The value of various feeds as supplements to whole wheat distillers' slop for fattening steers.

The relative values of granular wheat flour slop, whole wheat slop and corn and wheat slop for yearling steers.

The feeding value of distillery wheat slop for hogs.

A comparison of Reid's yellow dent corn with Kentucky 103 hybrid corn for steers in dry lot.

Life history and habits of the European Corn Borer *(Pyrausta nubilalis)* with special reference to control measures applicable to the southern states.

A study of farm production adjustments in the Pennyroyal Area of Kentucky (Type-of-Farming Area 5) to meet war needs.

A study of farm production adjustments in the lower Ohio River Valley (Type-of-Farming Area 7) to meet war needs.

Postwar needs of Kentucky agriculture and rural life.

Study of the simplification of present farm labor and equipment practices in the production of farm products in Kentucky.

PUBLICATIONS

BULLETINS

441. Marketing and pricing eggs in Kentucky. John B. Roberts. March, 1943.
442. The anomalini of Eastern North America with descriptions of the larvae and a key to species (Coleoptera: Scarabaeidae). P. O. Ritcher. March, 1943.
443. Farmers on local planning committees in three Kentucky counties, 1939-1940. Robin M. Williams and Howard W. Beers. May, 1943.
444. Distribution of temperature and relative humidity within a burley tobacco barn. Lester S. O'Bannon. May, 1943.
445. Control of green June beetle larvae *Cotinis nitida* (L.) in tobacco beds. H. H. Jewett. June, 1943.
446. Market movement of livestock in Kentucky. A. J. Brown and C. D. Phillips. June, 1943.
447. Iodine in soils, waters and farm products of Kentucky. J. S. McHargue and D. W. Young. June, 1943.
448. Prices of tobacco in different parts of Kentucky. Dana G. Card and James H. Clarke. June, 1943.
449. Weight of turkey eggs in relation to hatchability. W. M. Insko, Jr., Donald W. MacLaury, and E. A. Baute. June, 1943.

450. Rural neighborhoods and communities in thirteen Kentucky counties, 1941: size, population, and social structure. Frank Winchester. June, 1943.
451. Mobility and fertility rates of rural families in Robertson and Johnson Counties, Kentucky, 1918-1941. Irving A. Spaulding and Howard W. Beers. June, 1943.
452. Attitudes toward rural migration and family life in Johnson and Robertson Counties, Kentucky, 1941. Robin M. Williams and Howard W. Beers. June, 1943.
453. Cropping and soil management for burley tobacco. P. E. Karraker and C. E. Bortner. July, 1943.
454. Angular leafspot and wildfire of tobacco. W. D. Valleau, E. M. Johnson, and Stephen Diachun. October, 1943.

REGULATORY SERIES BULLETINS

34. Commercial fertilizers in Kentucky in 1942. J. D. Turner, H. R. Allen and Lelah Gault. June, 1943.
35. Commercial feeds in Kentucky in 1942. J. D. Turner, Stacy B. Randle, W. G. Terrell, and J. J. Rose. June, 1943.
36. Seed inspection in Kentucky in 1942-43. W. A. Price, E. C. Vaughn, Encil Deen, Howard Tilson, Alice McDaniel, Katharine Fried, Margaret Morton, Mary Lee Littrell, and Lucy Baugh. June, 1943.
37. Inspection, certification, and transportation of nursery stock in Kentucky with a brief report for the year ended June 30, 1943. W. A. Price and Howard G. Tilson. June, 1943.

EXPERIMENT STATION CIRCULAR

54. Supplement A. Serological identification of Salmonella cultures. P. R. Edwards and D. W. Bruner. September, 1943.

ANNUAL REPORT

Fifty-fifth annual report of the Experiment Station (for 1942). Thomas P. Cooper.

SCIENTIFIC PAPERS

In Agronomy

Changes in certain water-soluble nitrogenous constituents of burley tobacco during curing. James R. Young and R. N. Jeffrey. Plant Physiol. 18:433-448. July, 1943.

Chemical and strength differences in retted hemp fiber. Lyle E. Hessler. Presented at meeting of Amer. Soc. Agron., Cincinnati, Nov. 10-12, 1943.

Colonies of *Bacterium tabacum* on roots of wheat. Stephen Diachun, E. M. Johnson, and W. D. Valleau. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

Current developments in breeding southern crops—tobacco breeding. W. D. Valleau. Presented at meeting of Amer. Soc. Agron., Cincinnati, Nov. 10-12, 1943.

Determining magnesium in plants and soils—adaptation of the 8-hydroxyquinolate micromethod. Martin E. Weeks and Jack R. Todd. Indus. and Engin. Chem., Analyt. Ed. 15:297-299, April, 1943.

Effect of nitrogen on anther color in Kentucky bluegrass. Robert B. Griffith. Amer. Soc. Agron. Jour. 35:348-349. April, 1943.

A leaf disease of Kentucky bluegrass. Robert B. Griffith. Phytopathology 33:745. August, 1943.

Multiplication of tobacco leaf spot bacteria on roots of other species. Stephen Diachun, W. D. Valleau and E. M. Johnson. Abstract. Jour. Bact. 45:95. Jan., 1943.

An outbreak of *Plantago* virus in burley tobacco. W. D. Valleau and E. M. Johnson. Phytopathology 33:210-219. March, 1943.

Pathological problems in relation to grass improvement. John R. Hardison. Presented at meeting of Amer. Soc. Agron., Cincinnati, Nov. 10-12, 1943.

Tobacco leafspot bacteria on roots of pasture plants. W. D. Valleau, E. M. Johnson and Stephen Diachun. Presented at meeting of Amer. Soc. Agron., Cincinnati, Nov. 10-12, 1943.

Uptake of native and applied phosphorus by corn crops grown on certain Kentucky soils. Martin E. Weeks. Presented at annual meeting of Amer. Soc. Agron., Cincinnati, Nov. 10-12, 1943. To be published in Proceedings of Soil Science Society of America.

In Animal Husbandry and Dairying

Bluegrass and alfalfa silages as roughages for fattening steers. W. P. Garrigus. Jour. Anim. Sci. 2 (4):358. 1943.

A comparative genetic analysis of stakes winning and poor performing Thoroughbreds. Dewey G. Steele. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

Does boiling change the weight of an egg or of the yolk or white? G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Poultry Sci. 22:95. Jan. 1943.

How animals inherit. Dewey G. Steele. The Blood-Horse 40:707-708. 1943.

How serious is the taint in American Thoroughbreds. Dewey G. Steele. The Blood-Horse 39:167. Jan., 1943.

Methods of fattening late native lambs. W. P. Garrigus. Jour. Anim. Sci. 2: (4): 368. 1943.

Normal and abnormal appetites of laying hens and their influence on feeding experiments. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

The pH of the contents and mucosa of the alimentary tract, certain organs and fats of chickens. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

Preliminary report of pasture investigations technique. Jour. Dairy Sci. 26:353-369. April, 1943. H. B. Morrison, joint author with Committee on Pasture Research of the American Dairy Science Association.

Spring bluegrass versus mature bluegrass as pasture for laying hens. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Poultry Sci. 22:248-251. May, 1943.

Where pedigrees are important. Dewey G. Steele. The Blood-Horse 39:792-793. June, 1943.

How serious is the taint? Dewey G. Steele. The Blood-Horse 39:792-793. June, 1943.

In Animal Pathology

The American Veterinary Medical Association war conference. W. W. Dimock. Amer. Vet. Med. Assoc. Jour. 103 (No. 797):67-68. August, 1943.

Further studies on coliform bacteria serologically related to the genus Salmonella. P. R. Edwards, W. B. Cherry and D. W. Bruner. Jour. Infec. Dis. 73:229-238. November-December, 1943.

Horse and mule production. W. W. Dimock. Cornell Vet. 33 (2):182-197. April, 1943.

The occurrence and distribution of Salmonella types in the United States. P. R. Edwards and D. W. Bruner. Jour. Infect. Dis. 72:58-67, January-February, 1943.

Presidential address, W. W. Dimock. Amer. Vet. Med. Assoc. Jour. 103 (No. 798): 131-139, September, 1943.

A new Salmonella type: Salmonella mississippi. P. R. Edwards. Soc. Expt. Biol. and Med. Proc. 52:263-264. 1943.

Two new Salmonella types with similar somatic antigens. W. B. Cherry, P. R. Edwards and D. W. Bruner. Soc. Expt. Biol. and Med. Proc. 52:125-126. 1943.

In Chemistry

Excretion of manganese by the rat. J. T. Skinner and J. S. McHargue. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

A large-scale laboratory extractor of the Soxhlet type. Karl E. Rapp, C. W. Woodmansee, and J. S. McHargue. Indus. and Engin. Chem., Analyt. Ed. 15:351. May, 1943.

Some functions of mineral elements in connection with enzymatic action. J. T. Skinner. President's address at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

The influence of the halides on the oxidation of manganese in soil. G. D. Sherman, J. S. McHargue and R. H. Hageman. Soil Sci. 56:127-134, August, 1943.

Effect of boron deficiency on the soluble nitrogen and carbohydrate content of alfalfa. P. N. Scripture and J. S. McHargue. Amer. Soc. Agron. Jour. 35: 988-992, November, 1943.

Copper deficiency in tomatoes. L. F. Bailey and J. S. McHargue. Amer. Jour. Bot. 30:558-563. October, 1943.

Enzyme activity in tomato fruits and leaves at different stages of development. L. F. Bailey and J. S. McHargue. Amer. Jour. Bot. 30:763-766. December, 1943.

In Farm Economics

Beyond wartime changes in education. Howard W. Beers. Presented at Southeastern Ohio Teachers Association meeting, Athens, Ohio, November 5, 1943.

Kentucky population changes in relation to postwar school problems. Howard W. Beers. Bureau of School Service, Univ. of Ky., xvi:81-82, December, 1943.

Methods and attitudes in studying farm land tenure problems. W. D. Nicholls. Presented at Midwestern Regional Meeting on Land Tenure, Chicago. November 4, 1943.

Our responsibility for developing an adequate welfare program in Kentucky. Howard W. Beers. Presented at annual meeting Kentucky State Conference of Social Welfare, Louisville. November 21, 1943.

Population shifts in relation to industry in Kentucky. Howard W. Beers. Kentucky School Journal 21:15-19. April, 1943.

Social data affecting education in Kentucky counties. Howard W. Beers. Presented at Leadership Conference, College of Education, June, 1943.

Wartime changes in education. Howard W. Beers. Presented at Peabody Curriculum Conference, Nashville, Tennessee. July 22, 1943.

Wartime changes in education. Howard W. Beers. Peabody Reflector, xvi:326-328, 334. September, 1943.

In Feed and Fertilizer Control

The determination of crude fat in commercial feeds. Stacy B. Randle. Presented at annual meeting of Ky. Acad. Sci., April 23-24, 1943.

Factors affecting the determination of acid- and base-forming quality of fertilizers. H. R. Allen and Lelah Gault. Address at meeting of the Amer. Chem. Soc., Sept. 5, 1943.

Report on acid- and base-forming quality of fertilizers. H. R. Allen and Lelah Gault. Assoc. Off. Agr. Chem. Jour. 26:68-74. Feb., 1943.

Report on acid- and base-forming quality of fertilizers. H. R. Allen and Lelah Gault. Presented at meeting of Assoc. Off. Agr. Chem., Nov., 1943.

Report on fat in cooked animal feeds containing cereals (acid hydrolysis). Stacy B. Randle, Associate Referee. Assoc. Off. Agr. Chem. Jour. 26:340-346. 1943.

In Markets and Rural Finance

Graphic methods of presenting multiple correlation analysis. Dana G. Card. Jour. Farm Econ. 25:881-889. November, 1943.

FINANCIAL STATEMENT

Receipts and expenditures under Hatch, Adams, Purnell, and Bankhead-Jones Acts, and the State Offset Required by the Bankhead-Jones Act.

Fiscal year ended June 30, 1943

	Hatch	*Adams*	*Purnell*	*Bankhead-Jones*	*Bankhead-Jones Offset*
Receipts					
From the Treasurer of the United States as per appropriations for fiscal year ending June 30, 1943	$15,000.00	$15,000.00	$60,000.00	$81,533.32	
Receipts from sources within the state as Bankhead-Jones offset					$81,533.32
Expenditures					
Personal Services:					
Administration	3,300.00				
For construction or repair of buildings	74.17				
For all other purposes	10,673.15	14,117.63	52,411.50	73,823.36	
Travel			2,777.09	636.27	
Transportation of Things		11.86	13.09	18.79	
Communication Service			247.91		
Rents and Utility Services:					
Heat, light, power, water, gas, electricity			11.20		
Printing and Binding:					
Printing publications	389.00			791.33	
Other printing and binding	563.68	4.00	1,440.72	1,305.66	
Other Contractual Services:					
Repairs and alterations to equipment, and other contractual services not otherwise classified		7.34	424.45	156.65	
Repairs and alterations to buildings (not capital improvements)			2.70	21.16	
Supplies and Materials:					
Used in construction repair, or alteration of buildings				22.42	
Other supplies and materials		790.85	629.53	3,320.64	
Equipment		68.32	2,041.81	1,437.04	
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	81,533.32	
Unexpended balances June 30, 1943	.00	.00	.00	.00	
BANKHEAD-JONES OFFSET, TOTAL APPROVED EXPENDITURES	$81,533.32				

We, the undersigned, certify that the receipts and expenditures shown in this report from Federal funds and as offset to Bankhead-Jones funds are correct; that the expenditures were solely for the purposes set forth in the acts of Congress approved March 2, 1887 (Hatch), March 16, 1906 (Adams), February 24, 1925 (Purnell), May 16, 1928 (Hawaii), February 23, 1929 (Alaska), March 4, 1931 (Puerto Rico), June 29, 1935 (Bankhead-Jones Title I), June 20, 1936 (Alaska) and March 4, 1940 (Employer Contributions to Retirement); that the expenditures are in accordance with the terms of said acts so far as applicable to this station; and that properly approved vouchers are on file for all expenditures.

Signed:

THOMAS COOPER
Director of Experiment Station

FRANK D. PETERSON
Financial Officer of the Institution
Title Comptroller

1500-5-44